



Geospatial patterns of access to self-care resources for obesity among endometrial cancer survivors in a high poverty urban community

Jerlinda G.C. Ross^{a,*}, Veronica Escamilla^b, Nita Karnik Lee^a, S. Diane Yamada^a, Stacy Tessler Lindau^{c,d,e,f}

^a Department of Obstetrics and Gynecology, Section of Gynecologic Oncology, University of Chicago Pritzker School of Medicine, Chicago, IL, USA

^b Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, NC, USA

^c Department of Obstetrics and Gynecology, The University of Chicago, Chicago, IL, USA

^d Department of Medicine-Geriatrics, The University of Chicago, Chicago, IL, USA

^e The Comprehensive Cancer Center, The University of Chicago, Chicago, IL, USA

^f The MacLean Center on Clinical Medical Ethics, The University of Chicago, Chicago, IL, USA

HIGHLIGHTS

- Endometrial cancer survivors in lower SES communities have higher rates of obesity.
- Black/African American women had significantly higher rates of obesity-related comorbidity compared to other women.
- Patterns of access to survivorship obesity-related resources is variable depending on SES and race/ethnicity.
- Women in low SES areas had decreased access to obesity-related resources for weight management.

ARTICLE INFO

Article history:

Received 6 October 2018

Received in revised form 1 December 2018

Accepted 4 December 2018

Available online 20 December 2018

Keywords:

Endometrial cancer

Socioeconomic status

Obesity

Access

Yost index

ABSTRACT

Objective. To examine endometrial cancer survivors' access to recommended obesity-related self-care resources.

Methods. Participants included women treated 2010–2015 for endometrial cancer at an academic medical center who lived in the surrounding 16 ZIP code area on Chicago's South Side. Demographic and health data were abstracted from medical records. A socioeconomic status (SES) score (SES-1 = low, SES-5 = high) was generated for each patient using census block group-level data. Self-care resources for exercise, healthy weight, and diet were obtained from a community resource census. Geospatial techniques assessed "walkable access" (–1/2-mile radius around a patient's home) to obesity-related resources. Multivariable logistic regression investigated associations between access to obesity-related resources and patient characteristics.

Results. Of 195 endometrial cancer survivors, 81% identified as Black/African American and 34% lived in an SES-1 census block. Two thirds (68%) had Stage I or II endometrial cancer. Nearly two thirds (62%) were obese (BMI ≥ 30 kg/m²). Obesity was inversely associated with SES ($p = 0.05$). Two thirds of survivors had access to at least one of all three recommended resource types. Access was lower in low SES regions and among Black/African American women. Lower SES was associated with lower odds of walkable access to recommended resources (AOR for access to two of each resource type 0.75, 95%CI 0.59, 0.97; AOR for access to three or more of each 0.44, 95%CI 0.32, 0.61).

Conclusions. Obesity rates were higher and access to recommended resources was lower for Black/African American endometrial cancer survivors living in high poverty areas in Chicago.

© 2018 Elsevier Inc. All rights reserved.

1. Introduction

Endometrial cancer is the most prevalent gynecologic malignancy in the United States, with >600,000 living survivors in 2014 [1–3]. Over the last two decades, the steadily rising incidence of endometrial cancer has

paralleled rising obesity rates in the U.S. Obesity is a known risk factor for primary endometrial cancer, other malignancies including breast, colorectal, and kidney, cardiovascular disease, diabetes, and cerebrovascular disease [4–6]. Several reports demonstrate a higher rate of mortality and shortened life span in obese patients with endometrial cancer, attributable at least in part to obesity-related comorbidities [1,3,7–9]. Women with low grade, early stage endometrial cancer are more likely to die of cardiovascular disease as from their cancer [1,8,10]. Rates of endometrial cancer and obesity are higher and rising faster among Black/

* Corresponding author at: Penn Medicine Virtua Cancer Program, 401 Young Avenue Suite 146, Moorestown, NJ 08057, USA.

E-mail address: jross@virtua.org (J.G.C. Ross).

African American than White/Caucasian women [5,8,11]. This racial disparity is much more likely attributable to differential exogenous exposures than genetic differences between Black/African American and White/Caucasian women, including access to nutrition and fitness.

Influential medical organizations have launched multifaceted initiatives to combat the growing obesity epidemic among cancer patients. The Institute of Medicine's (IOM) 2006 Consensus Study Report on cancer survivorship goals and survivorship care planning, "From Cancer Patient to Cancer Survivor: Lost in Transition," recommends "healthy behaviors" including "exercise," "healthy weight," and "diet" [12]. In addition to healthy weight and regular physical activity, guidelines from an interdisciplinary group of cancer, nutrition and physical activity experts convened by the American Cancer Society specify that a healthy diet should include fresh fruits and vegetables [13]. The Gynecologic Cancer Self Care Plan developed by the Society of Gynecologic Oncology (SGO) advocates for similar self-care behaviors [14].

The American College of Surgeons Commission on Cancer (CoC) and American Society of Clinical Oncology (ASCO) also recommend resources for obesity prevention and weight management for cancer survivors [4,15]. Although differential access to these recommended resources could drive disparities in endometrial cancer outcomes and survivorship, very little is known about women's access to these resources.

We examined the geospatial distribution of self-care resources recommended for cancer survivors (exercise, healthy weight, and diet) to elucidate patterns of access among endometrial cancer survivors in an urban region with a predominantly Black/African American population. We hypothesized, based on prior studies that have examined geographic variations in access to obesity-related resources, that the distribution of and access to recommended self-care resources would vary geographically and in relation to socioeconomic and comorbidity status of endometrial cancer survivors.

2. Methods

2.1. Study population

The study population included patients seen by a gynecologic oncology practice at an urban academic medical center at least once between

1/1/2010 and 12/31/2015. Eligible patients were women with a diagnosis of Stages I–IV endometrioid, papillary serous, carcinosarcoma, clear cell, mixed, or undifferentiated endometrial cancer living in the study region. This study was conducted with approval from the University of Chicago Institutional Review Board.

2.2. Study region

The study region included the 16 contiguous ZIP code primary service area of the academic medical center. The 120 mi² area comprises 910 census block groups with a population of 1.06 million. More than half the study population lived at 200% or below federal poverty level (US Census 2015). The study region is shown in Fig. 1.

2.3. Self-care resource data

Location of all businesses and organizations offering exercise, diet, and healthy weight programs and services were obtained from the 2015 CommunityRx database [16]. The CommunityRx database, developed with a 2012–2015 Centers for Medicare & Medicaid Health Care Innovation Award, included current, comprehensive data about all open and operating businesses and organizations obtained via a primary asset census conducted annually in the region since 2009 [17]. In this analysis, exercise resources included gyms, fitness arts (such as martial arts, yoga, and dance), and any place that offered trainers, group exercise classes, and walking or jogging groups. Healthy weight resources included weight loss centers, healthy eating classes, weight management classes, and fitness education classes. Diet resources included places offering fresh fruits or vegetables, such as large grocery stores, small grocery stores, farmers' markets, and community gardens.

2.4. Individual-level data

Demographic (age at time of diagnosis, race, ethnicity, and address) and disease-related (stage, tumor grade, and histologic subtype) data were abstracted from the electronic medical record (EMR) for each patient. Comorbidity data from the EMR included a documented diagnosis of the following illnesses: diabetes mellitus (DM), hypertension (HTN),

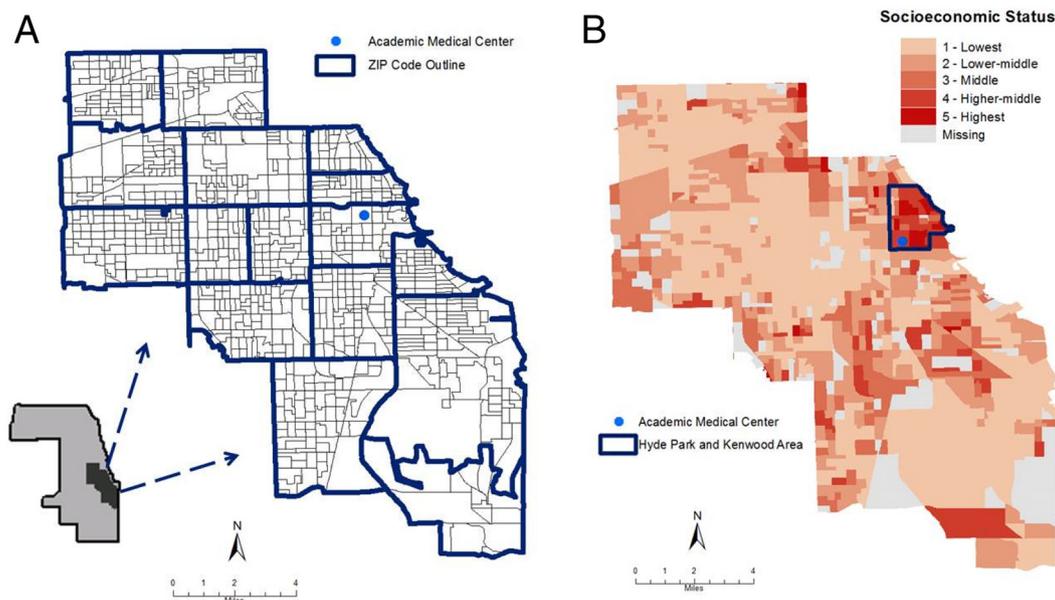


Fig. 1. A. 16 ZIP code study region in Chicago. The City of Chicago with the 16 ZIP code study region is illustrated above. Census block groups are shown within the ZIP codes, and the medical center is located to the right. B. Distribution of socioeconomic status by census block group in the study region. Note, that we outline in blue the Hyde Park and Kenwood area surrounding the Academic Medical Center. We highlight this area because it is distinct from the rest of the study area. It encompasses the University of Chicago, generally comprises higher SES block groups compared to the rest of the area, and has higher levels of accessible resources compared to the rest of the region.

coronary artery disease (CAD), hyperlipidemia, obstructive sleep apnea (OSA), and cerebral vascular accident (CVA). Diagnoses documented in the problem list were validated by review of provider notes. Self-reported height and measured weight data were abstracted from the patient's most recent clinic visit. Body mass index (BMI) was calculated as weight divided by height (kg/m^2). Obesity was defined as $\text{BMI} \geq 30 \text{ kg}/\text{m}^2$ and morbid obesity was defined as $\text{BMI} \geq 40 \text{ kg}/\text{m}^2$. We assigned patients a diagnosis of metabolic syndrome based on World Health Organization (WHO) criteria: a diagnosis of diabetes plus two or more conditions of obesity, dyslipidemia, or hypertension [18,19]. Low-grade endometrial cancers included grade 1 and grade 2 endometrioid histologies. High-grade endometrial cancer included grade 3 endometrioid, papillary serous, carcinosarcoma, clear cell, and mixed histologies. The number of total comorbidities was used as a comorbidity index [20].

SES information was obtained and aggregated at the census block group level using 2014 US Census Bureau data [21]. Census block level data have been shown to approximate SES measured at the individual level and can therefore be used as a proxy for patient SES [22,23]. Socioeconomic status (SES) was classified using the Yost score, a composite index calculated by principal component analysis using census block level characteristics including education, household income, poverty, house value, rent, rate of unemployment, and rate of blue collar employment [22]. The Yost score was divided into 5 categories based on increasing quintiles: lowest (SES-1), low-middle (SES-2), middle (SES-3), high-middle (SES-4), and highest (SES-5) [22,24]. Patients were assigned an SES score based on the census block group in which their residence was located.

2.5. Geospatial analyses

We evaluated the geospatial distribution of all three obesity-related recommended resource types in the study region using kernel density estimates [25]. For this method, a roaming window or kernel with a 1 km^2 radius was passed across the study region, and the density of resources was computed at the center of the window. Density was based on the weighted values of all resources in the window, and less weight was assigned to resources further from the center.

We defined patient access to recommended resources as the presence of a resource within a 1-kilometer (km) or $\frac{1}{2}$ -mile radius of the patient's residence using ArcGIS v10.3 (ESRI; Redlands, CA). This definition of access was derived from the U.S. federal government definition of "walkable" distance to characterize access in urban areas [26]. Using the buffer and intersect tools, a $\frac{1}{2}$ -mile radius was drawn around each residence, and the following resource availability variables were calculated: 1) presence of only 1 of any of the three recommended resource types (insufficient access), 2) presence of only 1 of each of the three recommended resource types (bare minimum access), 3) presence of only 2 of each of the three recommended resource types (limited choice access), and 4) presence of 3 or more of each of the three recommended resource types (options access).

2.6. Statistical analyses

Descriptive statistics were used to describe sample characteristics and to compare obesity-related comorbidity prevalence by endometrial cancer grade and patient SES. Chi-square tests were used to analyze categorical variables. In instances where categorical variables had cells with fewer than five observations, Fisher's exact test was used. *t*-Tests were used to analyze continuous variables.

We first examined the relationship between patient access to recommended resources and SES using descriptive statistics. A multivariable logistic regression model was then used to identify patient factors independently associated with access to recommended resources based on the resource access variables described above (insufficient access, bare minimum access, limited choice access, and options access).

The model included variables known to affect access to exercise, healthy weight, and diet resources based on prior literature, specifically race/ethnicity and obesity [27–30]. Race/ethnicity was a categorical dichotomous variable defined as Black/African American or other. Obesity was a categorical dichotomous variable defined as a $\text{BMI} \geq 30 \text{ kg}/\text{m}^2$.

Statistical analyses were conducted using SPSS version 23 (2014, IBM Corp., Armonk, NY) and Stata version 14 (2015, StataCorp, College Station, TX, USA). A threshold of statistical significance of 0.05 was used for all analyses.

3. Results

Study participants included 195 women with endometrial cancer living in the 16 ZIP code study region (Table 1). Mean age at diagnosis was 63.9 years (range 32–88 years). The majority of patients identified as Black/African American (81%). Half of patients (48%) had low-grade endometrial cancer and 68% had early stage (Stage I and Stage II) disease. Socioeconomic status scores were unevenly distributed across the region (Fig. 1B); 80% of census tracts were SES-1 and SES-2. More than a third of endometrial cancer survivors were in the lowest SES group. Endometrial cancer disease stage was similar among Black/African American and other patients. Although not a statistically significant difference, Black/African American patients had a higher prevalence of high-grade disease compared to all other racial/ethnic groups (55% vs. 40%, $p = 0.08$). Black/African American women were more likely than other women to be classified in the lowest SES groups (60% versus 42%, $p = 0.02$).

The most prevalent comorbidities among women with endometrial cancer were hypertension (78%), obesity (62%), diabetes (33%), hyperlipidemia (32%) and metabolic syndrome (26%) (Table 2). The mean BMI was $33.9 \text{ kg}/\text{m}^2$ (range 11.6–68.7). Nearly 40% of endometrial cancer patients had 3 or more comorbid diagnoses. Women with low-grade endometrial cancers had significantly higher rates of comorbid obesity

Table 1
Study population characteristics (N = 195).

Characteristic	N (%)
Age at the time of diagnosis, years \pm SD [range]	63.9 \pm 10.5 [32–88]
Race/ethnicity	
Black/African American, non-Hispanic	157 (80.5)
White/Caucasian, non-Hispanic	22 (11.3)
Hispanic (non-Black)	13 (6.7)
Other	3 (1.5)
SES*	
1 (Lowest)	67 (34)
2 (Lower-middle)	43 (22)
3 (Middle)	52 (27)
4 (Higher-middle)	21 (11)
5 (Highest)	12 (6)
Stage	
I	122 (62.5)
II	11 (5.6)
III	35 (17.9)
IV	26 (13.3)
Not staged	1 (0.5)
Endometrial cancer tumor grade	
1	60 (30.8)
2	33 (16.9)
3	102 (52.3)
Endometrial cancer tumor histology	
Endometrioid	113 (57.9)
Papillary serous	38 (19.4)
Carcinosarcoma	26 (13.3)
Clear cell	9 (4.6)
Mixed	9 (4.6)

Note: All values listed as N (%), except for age which is listed as mean \pm standard deviation [range].

* Median household income for each SES score: \$21,050 (SES-1), \$34,047 (SES-2), \$48,025 (SES-3), \$60,536 (SES-4), and \$85,144 (SES-5).

Table 2
Patient comorbidities stratified by cancer grade.

Comorbidity	All patients (N = 195)	Low-grade patients (N = 93)	High-grade patients (N = 102)	p-Value
BMI kg/m ² [mean (SD)]	33.9 (10.3)	37.4 (11.3)	30.8 (8.1)	<0.001
Obesity (BMI > 30 kg/m ²)	121 (62.1)	70 (75.3)	51 (50.0)	<0.0001
Morbid obesity (BMI > 40 kg/m ²)	47 (24.1)	33 (35.5)	14 (13.7)	<0.0001
Hypertension	153 (78.4)	64 (68.8)	89 (87.3)	0.003
Diabetes	64 (32.8)	33 (35.5)	31 (30.4)	0.54
Hyperlipidemia	63 (32.3)	26 (28.0)	37 (36.2)	0.22
Coronary artery disease	37 (19.0)	15 (16.1)	22 (21.6)	0.37
Cerebrovascular accident	16 (8.2)	5 (5.4)	11 (10.8)	0.20
Metabolic syndrome	51 (26.2)	26 (28.0)	25 (24.5)	0.83
≥3 comorbidities	76 (39.0)	35 (37.6)	41 (40.2)	0.71
Personal cancer history	40 (20.5)	19 (20.4)	21 (20.6)	1.0
Breast		10	16	
Colorectal		3	2	
Ovary		2	0	
Pancreatic/gastrointestinal		1	0	
Other		5*	3**	

Note: All values listed as N (%), except BMI which is listed as mean (standard deviation).

* Other personal cancer history includes multiple myeloma (1), Hodgkin's lymphoma (1), lung cancer (1), melanoma (1), basal cell skin cancer (1), cervical cancer (1).

** Other personal cancer history includes kidney (2), cervical cancer (1), non-melanoma skin cancer (1).

compared to women with high-grade cancers. Still, half of high-grade endometrial cancer patients were obese and 87% had hypertension.

The prevalence of multiple comorbid diagnoses (3 or more) was 6 times higher for women in the lowest SES group (51%) as compared to the highest SES group (8%) (Table 3). Rates of obesity were significantly and inversely associated with SES. There were zero documented cases of cerebrovascular accident (CVA) among patients in the highest SES groups (SES-4, 5), compared to a 26% prevalence in the lower SES groups (SES-1, 2, 3). Black/African American women with endometrial cancer were more likely to have three or more comorbidities when compared to other racial/ethnic groups (Supplementary Table 1). Although rates of obesity were similar among Black/African American and other endometrial cancer patients, Black/African American patients had a higher prevalence of obesity-associated comorbidities, including HTN, DM, metabolic syndrome and CVA (Supplementary Table 1).

The density of each recommended resource type in the study region is shown in Fig. 2. Patient access differed by SES group (Fig. 3). All women in the highest SES group (SES-5) and two-thirds of the women in the high-middle SES group (SES-4) had options access (at least 3 options each for exercise, healthy weight, and diet resources within a ½ mile radius of their residence) to the recommended self-care resources. Nearly a third of women in SES-1 (31%) and SES-2 (30%) and almost half in SES-3 (49%) had insufficient access. More than a third of Black/African American women (36%) had insufficient access. Of those Black/African American women with insufficient access, 92% were in the three lowest SES groups [SES-1 (31%), SES-2 (19%), SES-3 (42%)].

Multivariable logistic regression models, adjusted for race and obesity, were used to identify patient factors associated with access to recommended exercise, healthy weight, and diet resources. Socioeconomic status was inversely related to resource access. Endometrial cancer survivors in the lower SES groups (SES1–3) had lower access to 2 resources of each type (limited choice) or 3 or more resources of each type (options access) for exercise, healthy weight, and diet resource types (AOR 0.75, 95%CI 0.59, 0.97; AOR 0.44, 95%CI 0.32, 0.61).

4. Discussion

This study examines, in a high poverty, predominantly African American urban community, endometrial cancer survivors' access to obesity-related self-care resources recommended by the Society of Gynecologic Oncology (SGO) and Commission on Cancer (CoC). To our knowledge, no studies have examined, using high quality data about community resources and geospatial analytic techniques, endometrial

cancer survivors' access to recommended self-care resources [17]. We find that endometrial cancer survivors living in lower SES conditions had both higher rates of obesity and other comorbidities and poorer access to recommended obesity-related resources. All women living in the highest SES area had access to 3 or more of each recommended resource type or "options access." In contrast, more than a third of Black/African American women had insufficient access to exercise, weight management, and diet resources within a walkable distance of their residence. Furthermore, 60% of Black/African American endometrial cancer survivors lived in the two lowest SES groups.

Although we found similar rates of obesity among Black/African American and other women in our study, Black/African American women had significantly higher rates of obesity-related comorbidity, including diabetes, hypertension, metabolic syndrome and stroke and were more likely than other women to have more complex physical and medical comorbidity. These findings corroborate similar evidence from prior studies [31,32] and highlight the importance of nearby or walkable access to recommended resources, especially for women with physically disabling conditions like morbid obesity and stroke. Differential access to self-care resources may drive socioeconomic and racial disparities in adherence to SGO- and CoC-recommended survivorship goals and outcomes. This differential access based on SES and race/ethnicity to obesity related self-care resources may influence these women and similar endometrial cancer patients' adherence to these survivorship goals.

Clinical guidelines say little about optimal distribution of recommended self-care resources for prevention or management of obesity, or strategies oncology providers could use to effectively connect endometrial cancer patients to community resources. Our study gives insight to patterns of access that should be considered in future iterations of survivorship care plans and self-care guidelines. Most endometrial cancer patients living in this study region, with the exception of the highest SES groups, had insufficient or limited choice access to recommended resources. In addition to geographic distance, other factors, including a choice among viable options, should also be considered when examining access to obesity-related resources. Women in lower SES-areas had low access to any resource type and fewer options than other women. New evidence and solutions are emerging that enable physicians to make high quality referrals to community-based self-care resources, but have not been studied in the context of survivorship care. [16,33]

Interpretation of these study findings should consider several limitations. First, this was a single-site observational study and therefore may not generalize to other populations or individual-level interventions.

Table 3
Patient clinical and comorbidity characteristics stratified by socioeconomic status.

Characteristic	SES-score				
	1 n (%)	2 n (%)	3 n (%)	4 n (%)	5 n (%)
Total = 195	67 (34)	43 (22)	52 (27)	21 (11)	12 (6)
Low-grade endometrial cancer	34 (51)	20 (47)	26 (50)	9 (43)	4 (33)
High-grade endometrial cancer	33 (49)	23 (53)	26 (50)	12 (57)	8 (67)
Obese (BMI > 30)*	46 (69)	29 (67)	32 (62)	11 (52)	3 (25)
Hypertension	56 (84)	30 (70)	44 (85)	16 (76)	7 (58)
Diabetes	25 (37)	17 (40)	15 (29)	6 (29)	1 (8)
Coronary artery disease (CAD)	12 (18)	14 (33)	7 (13)	4 (19)	0 (0)
Hyperlipidemia	27 (40)	13 (30)	14 (27)	6 (29)	3 (25)
Metabolic syndrome	19 (28)	13 (30)	14 (27)	5 (24)	0 (0)
Obstructive sleep apnea	11 (16)	7 (16)	8 (15)	1 (5)	1 (8)
Cerebral vascular accident (CVA)*	11 (16)	1 (2)	4 (8)	0 (0)	0 (0)
Number of comorbidities (median, range)	3 (0–5)	2 (0–5)	2 (0–6)	2 (0–4)	1 (0–3)
≥3 comorbidities	34 (51)	16 (37)	18 (35)	7 (33)	1 (8)

Note: All values listed as number of affected patients in each SES group (percent), except for number of comorbidities, which is listed as median number of comorbidities within each SES group (range).

* *p*-Value ≤ 0.05.

Reflecting the population served, the majority of women identified as Black or African American; the study had relatively low power to make comparisons by race and ethnicity. Health and sociodemographic data were abstracted from medical records, which may lack in completeness and accuracy. The quality of community resource data, obtained annually by primary observation, is a unique strength, but this study was unable to assess the quality of programs and services delivered by these businesses and organizations. Additionally, this study did not assess individual referrals to resources or utilization of resources.

Gynecologic oncologists commonly provide care for their endometrial cancer patients through at least the early phases of the survivorship period. The impact of survivorship care recommendations on the health and quality of life of endometrial cancer patients depends heavily on a woman's ability to maintain her health and manage the tasks of living with chronic illness outside the oncologist's office. Cancer care providers should be aware that deficiencies, not only in available resources, but also in dependable knowledge about these resources in high

poverty communities might limit meaningful implementation of survivorship guidelines.

Supplemental data to this article can be found online at <https://doi.org/10.1016/j.ygyno.2018.12.005>.

Funding

Dr. Ross was supported by philanthropic funds from the Field Family Fellowship and Drs. Ross and Escamilla were supported by Bears Care, the charitable arm of the Chicago Bears. Drs. Lindau and Escamilla were supported in part by individual philanthropy to the Lindau Laboratory at the University of Chicago. This study uses data from CommunityRx. CommunityRx was supported in part by award number 1C1CMS330997-01-00 (ST Lindau, PI) from the Centers for Medicare & Medicaid Services and research reported in this publication, including Dr. Lindau's effort, was supported in part by the National Institute on Aging of the National Institutes of Health under award number R01AG047869 (ST Lindau, PI). The content is solely the responsibility

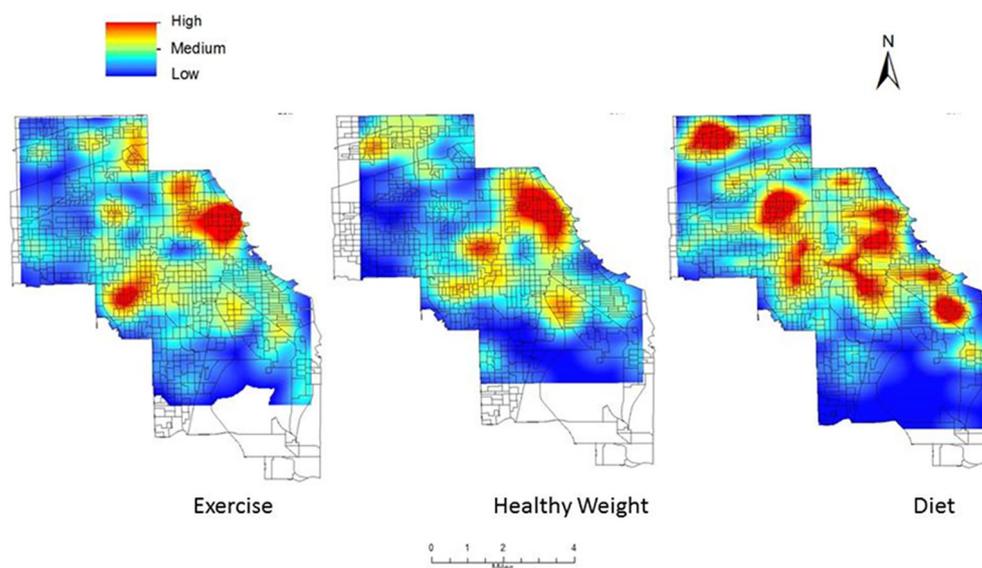


Fig. 2. Density of each SGO-recommended obesity-related resource type within the 16 ZIP code study region. The density of each obesity-related self-care resource recommended by SGO is shown in the figure. Exercise density resource range was 0 exercise resource per km² (low) to 5.6 per km² (high). Healthy weight resource density range was 0 healthy weight resource per km² (low) to 2.7 per km² (high). Diet resource density range was 0 diet resource per km² (low) to 4.9 per km² (high). Square kilometer was chosen to measure the density and access because it equates to ~1/2-mile, the U.S. federal government definition of “walkable” distance in urban areas.

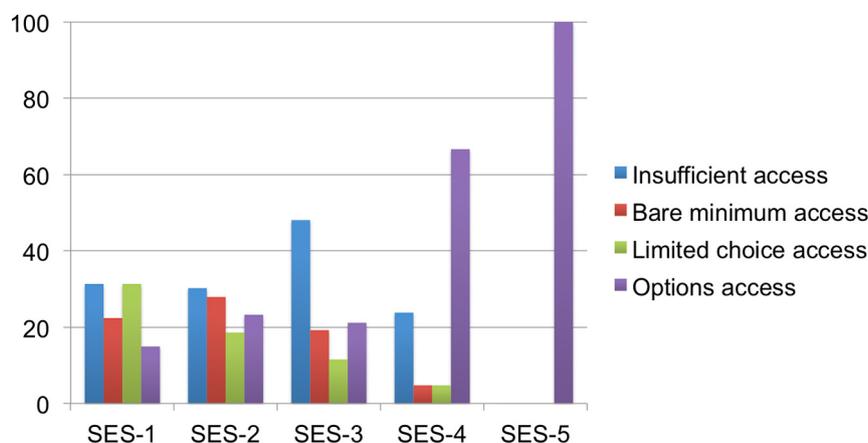


Fig. 3. Access to obesity-related resources by socioeconomic status. Patient access to exercise, healthy weight, and diet resources within a ½ mile radius of their homes significantly differed by socioeconomic status. All of the women in SES-5 and 65% of women in SES-4 had options access. However, in the lower SES groups (SES-1, SES-2, and SES-3), 50–70% of women had only insufficient or bare minimum access.

of the authors and does not necessarily represent the official views of the National Institutes of Health, the Centers for Medicare & Medicaid Services or any private funder of the work. The funders had no involvement in the study design, collection, analysis, interpretation of data, writing of the report or decision to submit the paper for publication.

Disclosures/conflict of interest statement

Under the terms of the CMS funding opportunity, awardees were expected to develop a sustainable business model to continue and support the model that we tested after award funding ends. Dr. Stacy Lindau is the founder and owner of a social impact company NowPow, LLC. She is also President of the Board of MAPSCorps 501(c)(3). Neither the University of Chicago nor the University of Chicago Medicine is endorsing or promoting any NowPow or MAPSCorps Entity or its business, products, or services.

Acknowledgment

We thank Dr. Michael Cailas for assistance with geographic information systems and Dr. Kristin Osiecki, both from the School of Public Health at the University of Illinois at Chicago, for contributing to this work.

References

- [1] K.K. Ward, et al., Cardiovascular disease is the leading cause of death among endometrial cancer patients, *Gynecol. Oncol.* 126 (2) (2012) 176–179.
- [2] K. Basen-Engquist, et al., Physical activity and obesity in endometrial cancer survivors: associations with pain, fatigue, and physical functioning, *Am. J. Obstet. Gynecol.* 200 (3) (2009) 288.e1–288.e8.
- [3] R.L. Siegel, K.D. Miller, A. Jemal, Cancer statistics, 2016, *CA Cancer J. Clin.* 66 (1) (2016) 7–30.
- [4] J.A. Ligibel, et al., American Society of Clinical Oncology position statement on obesity and cancer, *J. Clin. Oncol.* 32 (31) (2014) 3568–3574.
- [5] H. Greenlee, et al., Trends in obesity prevalence in adults with a history of cancer: results from the US National Health Interview Survey, 1997 to 2014, *J. Clin. Oncol.* 34 (26) (2016) 3133–3140.
- [6] J.J. Griggs, M.S. Sabel, Obesity and cancer treatment: weighing the evidence, *J. Clin. Oncol.* 26 (25) (2008) 4060–4062.
- [7] H. Arem, M.L. Irwin, Obesity and endometrial cancer survival: a systematic review, *Int. J. Obes.* 37 (5) (2013) 634–639.
- [8] V.E. von Gruenigen, et al., Treatment effects, disease recurrence, and survival in obese women with early endometrial carcinoma: a Gynecologic Oncology Group study, *Cancer* 107 (12) (2006) 2786–2791.
- [9] E.E. Calle, et al., Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults, *N. Engl. J. Med.* 348 (17) (2003) 1625–1638.
- [10] A.N. Fader, et al., Endometrial cancer and obesity: epidemiology, biomarkers, prevention and survivorship, *Gynecol. Oncol.* 114 (1) (2009) 121–127.
- [11] M.L. Cote, et al., The growing burden of endometrial cancer: a major racial disparity affecting black women, *Cancer Epidemiol. Biomark. Prev.* 24 (9) (2015) 1407–1415.
- [12] M. Hewitt, in: S. Greenfield, E. Stovall (Eds.), *From Cancer Patient to Cancer Survivor: Lost in Transition*, Washington, DC, Committee on Cancer Survivorship: Improving Care & Quality of Life, National Cancer Policy Board, Institute of Medicine and National Research Council, National Academies Press 2006, pp. 141–153.
- [13] C.L. Rock, et al., Nutrition and physical activity guidelines for cancer survivors, *CA Cancer J. Clin.* 62 (4) (2012) 275–276.
- [14] Society of Gynecologic Oncology, 2018, 2018 Survivorship Wellness and Preventive Health [Internet]. [cited 7/16/18]. Available from: <https://www.sgo.org/wp-content/uploads/2018/06/2018-Survivorship-Wellness-Prevention-FWC-SGO.pdf>.
- [15] American College of Surgeons Commission, *Cancer Program Standards 2012: Ensuring Patient-centered Care*, 2011.
- [16] S.T. Lindau, et al., CommunityRx: a population health improvement innovation that connects clinics to communities, *Health Aff.* 35 (11) (2016) 2020–2029.
- [17] S.T. Lindau, et al., A community-powered, asset-based approach to intersectoral urban health system planning in Chicago, *Am. J. Public Health* 106 (10) (2016) 1872–1878.
- [18] R.H. Eckel, S.M. Grundy, P.Z. Zimmet, The metabolic syndrome, *Lancet* 365 (9468) (2005) 1415–1428.
- [19] S.M. Grundy, et al., Definition of metabolic syndrome: report of the National Heart, Lung, and Blood Institute/American Heart Association conference on scientific issues related to definition, *Circulation* 109 (3) (2004) 433–438.
- [20] V. de Groot, et al., How to measure comorbidity: a critical review of available methods, *J. Clin. Epidemiol.* 56 (3) (2003) 221–229.
- [21] U.S.C. Bureau, *U.S. Census Bureau American Community Survey Estimates*, 2014.
- [22] K. Yost, et al., Socioeconomic status and breast cancer incidence in California for different race/ethnic groups, *Cancer Causes Control* 12 (8) (2001) 703–711.
- [23] N. Krieger, D.R. Williams, N.E. Moss, Measuring social class in US public health research: concepts, methodologies, and guidelines, *Annu. Rev. Public Health* 18 (1997) 341–378.
- [24] K.J. Yost, et al., Predictors of health-related quality of life in patients with colorectal cancer, *Health Qual. Life Outcomes* 6 (2008) 66.
- [25] B.W. Silverman, *Density estimation for statistics and data analysis*, Monographs on Statistics and Applied Probability, ix, Chapman & Hall/CRC, Boca Raton, 1998, 175 pp.
- [26] M. Ver Ploeg, et al., *Access to Affordable and Nutritious Food—Measuring and Understanding Food Deserts and Their Consequences: Report to Congress*, Vol. Administrative Publication (AP-036) 160, 2009.
- [27] B.D. Smedley, A.Y. Stith, A.R. Nelson (Eds.), *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*, 2003, Washington (DC).
- [28] P.A. Estabrooks, R.E. Lee, N.C. Gyurcsik, Resources for physical activity participation: does availability and accessibility differ by neighborhood socioeconomic status? *Ann. Behav. Med.* 25 (2) (2003) 100–104.
- [29] R.E. Walker, C.R. Keane, J.G. Burke, Disparities and access to healthy food in the United States: a review of food deserts literature, *Health Place* 16 (5) (2010) 876–884.
- [30] N.I. Larson, M.T. Story, M.C. Nelson, Neighborhood environments: disparities in access to healthy foods in the U.S., *Am. J. Prev. Med.* 36 (1) (2009) 74–81.
- [31] N.L. Keenan, et al., Coronary heart disease and stroke deaths — United States, 2006, *MMWR Suppl.* 60 (1) (2011) 62–66.
- [32] P.A. Meyer, et al., Introduction: CDC health disparities and inequalities report — United States, 2013, *MMWR Suppl.* 62 (3) (2013) 3–5.
- [33] L.M. Gottlieb, H. Wing, N.E. Adler, A systematic review of interventions on patients' social and economic needs, *Am. J. Prev. Med.* 53 (5) (2017) 719–729.