The impact of neighborhood disadvantage on colorectal cancer screening among African Americans in Chicago

Paula Lozano [a,*], Fornessa T. Randal [b], Aven Peters [b], Briseis Aschebrook-Kilfoy [c,d], Muhammad G. Kibriya [c,d], Jiajun Luo [d], Sameep Shah [d], Paul Zakin [d], Andrew Craver [d], Liz Stepniak [c,d], Loren Saulsberry [c,e], Sonia Kupfer [a,e], Helen Lam [a], Habibul Ahsan [c,d], Karen E. Kim [a,e]

[a] Department of Medicine, University of Chicago, Chicago, IL, USA
[b] Asian Health Coalition, Chicago, IL, USA
[c] Department of Public Health Sciences, University of Chicago, Chicago, IL, USA
[d] Institute for Population and Precision Health, University of Chicago, Chicago, IL, USA
[e] Comprehensive Cancer Center, University of Chicago, Chicago, IL, USA

ABSTRACT

Historically, colorectal cancer (CRC) screening rates have been lower among African Americans. Previous studies that have examined the relationship between community characteristics and adherence to CRC screening have generally focused on a single community parameter, making it challenging to evaluate the overall impact of the social and built environment. In this study, we will estimate the overall effect of social and built environment and identify the most important community factors relevant to CRC screening. Data are from the Multiethnic Prevention and Surveillance Study (COMPASS), a longitudinal study among adults in Chicago, collected between May 2013 to March 2020. A total 2,836 African Americans completed the survey. Participants' addresses were geocoded and linked to seven community characteristics (i.e., community safety, community crime, household poverty, community unemployment, housing cost burden, housing vacancies, low food access). A structured questionnaire measured adherence to CRC screening. Weighted quantile sum (WQS) regression was used to evaluate the impact of community disadvantages on CRC screening. When analyzing all community characteristics as a mixture, overall community disadvantage was associated with less adherence to CRC screening even after controlling for individual-level factors. In the adjusted WQS model, unemployment was the most important community characteristic (37.6%), followed by community insecurity (26.1%) and severe housing cost burden (16.3%). Results from this study indicate that successful efforts to improve adherence to CRC screening rates should prioritize individuals living in communities with high rates of insecurity and low socioeconomic status.

1. Introduction

Colorectal cancer (CRC) is the third leading cause of cancer-related death in the United States (Siegel et al., 2017; Siegel et al., 2017; Siegel et al., 2017), accounting for approximately 6% and 8% of both cancer incidence and mortality respectively (Siegel et al., 2020). The U. S. Preventive Services Task Force (USPSTF) recommends routine screening at age 50 for all persons at average risk using a combination of the following: fecal occult blood tests (FOBT) annually, flexible sigmoidoscopy every 5 years, or colonoscopy every 10 years (Bibbins-Domingo et al., 2016; Rex et al., 2017). Past research has found that most CRC is preventable with regular screening that is within the recommended guidelines and the removal of pre-cancerous polyps (Shapiro et al., 2008). However, as of 2018 CRC screening rates remain low (67%) relative to other types of cancer screening including breast cancer (73%) and cervical cancer (81%) (Institute and Progress, 2020). Although national data suggests that CRC screening has increased over time, disparities in CRC screening remain by age (O'Malley et al., 2005; Jerant, 2004), sex (O'Malley et al., 2005; Jerant, 2004; Adams, 2004), individual level socio-economic status (e.g., income, education) (O'Malley

et al., 2005; Adams, 2004; Seeff et al., 2004), health insurance availability (Adams, 2004; Ioannou et al., 2003; de Bosset et al., 2008) and race/ethnicity (Ioannou et al., 2003).

Historically, CRC screening have been lower among African Americans (Shapiro et al., 2008; Ioannou et al., 2003; Berry et al., 2009; Robillard and Larkey, 2009; Richards and Reker, 2002). However, a recent report from the Centers for Disease Control on screening behavior in 2018 indicates that there is no statistical difference in colorectal cancer screening between whites and African Americans, with 71.0% of whites and 70.0% of blacks reporting being up to date with colorectal cancer screening in the United States (based on data from BRFSS) (Joseph et al., 2020). Yet, in Chicago, the Chicago Department of Public Health (CDPH) reports that colorectal cancer screening in 2018 was 66.7% with African Americans reporting a rate of 63.7% (Illinois Department of Public Health, 2006). Moreover, the CDPH report includes wide variation at the community level, with some communities reporting screening rates as low as 30.8% (Adams, 2004; Illinois Department of Public Health, 2006).

Chicago, is geographically and racially segregated (Estime and Williams, 2021; Novara and Khare, 2017). Almost half of Chicago's communities are located on the South Side (Estime and Williams, 2021; Novara and Khare, 2017), totaling nearly 800,000 residents, most of which are African American (78%). African American communities in the South Side of Chicago have historically been afflicted by systemic injustice and racism, resulting in communities characterized by outdated, overcrowded housing due to lingering effects of policies like governmental redlining and exclusionary zoning practices intended to segregate low income families and minorities in Chicago (Estime and Williams, 2021; Novara and Khare, 2017). In fact, a recent study suggests that residents of affluent northern communities in Chicago are expected to live 30 years longer, earn five times the income and live in homes worth five times the value of their counterpart in the south side (Estime and Williams, 2021). Limited access to facilities and resources among residents in the South Side of the city may limit their ability to receive adequate healthcare including regular and high-quality cancer screening (Cohen, 2016). In fact, a study in Chicago, found that although residents in the South Side experienced the highest breast cancer mortality rates in the city, there were fewer screening services, such as mammogram testing sites, for women in these areas (Northwestern University, 2011). Cancer disparities have been attributed to poor screening quality, quality of treatment, stages of diagnosis and social determinants of health such (e.g., social and built environment) (Masi and Gehlert, 2009; Illinois Department of Public Health, 2022).

Indeed, there has been increased recognition that improving health and achieving health equity will require efforts to address non-medical, social determinants of health (Health and Organization, 2008; Lofters et al., 2017; Kurani et al., 2020). Previous studies suggest that community factors, including community socioeconomic indicators (i.e. poverty, deprivation, household income, unemployment rate), crowded housing, perceived community quality (e.g. free of garbage, safe from crime) and distance to a screening facility, have an impact on adherence to CRC screening among all racial/ethnic groups (i.e., Whites, African Americans, Hispanic, Asians) (Kurani et al., 2020; Calo et al., 2015; Danos et al., 2018; Fukuda et al., 2005; Lian et al., 2008; Buehler et al., 2019; Beyer et al., 2016; Mayhand et al., 2021; Shariff-Marco, 2013; Schootman, 2006). Studies that have exclusively focused on African American populations have found that individual perceptions of the social environment such as social capital (Leader and Michael, 2013) and community satisfaction (Halbert et al., 2016) are associated with increased likelihood of being screened for CRC. Additionally, a study among African Americans in Philadelphia found that participants living in racially segregated areas were less likely to be screened for CRC (Buehler et al., 2019). In this study, census tract measures (i.e., poverty, violent crime, community safety) were not significantly associated with CRC screening after adjusting for individual level factors (Buehler et al., 2019). Prior studies have generally focused on a single community

parameter, making it challenging to evaluate the overall impact of the social and built environment and to identify the most important community characteristics that impact CRC screening. Identifying these community characteristics will help inform future interventions that seek to improve low adherence in CRC screening through addressing social determinants of health. Due to its large urban population and wide variation in community-level factors, Chicago presents a unique opportunity to address this gap in knowledge.

Since 2013, we have been enrolling a predominantly African American cohort on the South Side of Chicago into the Chicago Multiethnic Prevention and Surveillance Study (COMPASS) with a stated goal of mitigating cancer disparities (Aschebrook-Kilfoy et al., 2020). As such, we have collected extensive data to understand the impact of individual, genetic, molecular, environmental, and community contextual factors relevant for cancer prevention and outcomes disparity mitigation. In this study, we aim to examine how community-level factors influence adherence to CRC screening among African Americans. We will estimate the overall effect of community environment and identify the most important community factors relevant to CRC screening. Findings from this study may be relevant for other high-risk urban communities and beyond.

2. Methods

2.1. Study design

We analyzed data from COMPASS, a population-based cohort study designed to accrue multiple decades of follow up to identify etiologic answers, roots of disparities, and opportunities for precision health promotion and disease prevention. Participants were recruited using a population-based approach, a community-based recruitment approach, and a hospital/clinic-based recruitment approach (Aschebrook-Kilfoy et al., 2020). The multiple recruitment modalities were considered in the early phase of this project in order to capitalize on the strengths and challenges of our Chicago context. Data collection took place from 2013 until it was interrupted by the COVID-19 pandemic in March 2020. A more detailed description of the methodology can be found elsewhere (Aschebrook-Kilfoy et al., 2020).

2.2. Study population

For this analysis we restricted COMPASS dataset to include participants between 50 and 75 years of age, who resided in Chicago community areas and self-identified as African American.

Participants' home addresses were geocoded and linked to Chicago's officially designated community areas, most of which are racially and ethnically homogenous and capture socially meaningful community boundaries (Whitman et al., 2011). Addresses provided by participants also allowed for linkage to community contextual factors using the Chicago Health Atlas data source (Atlas and Atlas, 2021). The Chicago Health Atlas is a free community health data resource, developed by the Chicago Department of Public Health in partnership with technology-focused organizations. This resource makes community-level health data for Chicago's 77 community available to residents, community organizations, and public health stakeholders (City Tech Collaborative, 2021).

From an initial sample size of 3,786 participants, we excluded 408 participants with missing data on adherence to CRC screening, 456 participants with missing data for individual-level factors (i.e., sex, income, education, health insurance, and marital status) and 86 participants with missing data on community-level factors. The final sample size for this study was 2,836 participants. The study included participants living in 61 communities with a mean of 46 participants per community. The University of Chicago Institutional Review Board granted approval for this study.

3. Measures

3.1. Adherence to CRC screening

We access adherence to CRC screening by asking the following question: "Have you ever had a colorectal cancer screening (colonoscopy, sigmoidoscopy, or barium enema to examine the colon and rectum)?" (yes/no).

3.2. Community-level factors

We selected community-level factors that have been previously found to predict adherence to CRC screening (Kurani et al., 2020; Calo et al., 2015; Danos et al., 2018; Fukuda et al., 2005; Lian et al., 2008; Buehler et al., 2019; Beyer et al., 2016; Mayhand et al., 2021; Shariff-Marco, 2013; Schootman, 2006) and that coincided with the Social determinants of Health framework (People, 2030). A detailed description of these community-level factors is included on Table 1. We selected several community socioeconomic factors (i.e., community safety, community crime, household poverty, community unemployment, housing cost burden) and features of the built environment (i.e., housing vacancies, low food access). Participants was assigned an average prevalence or count for each community-level variable. Community-level variables were then categorized into quartiles based on the number of participants in each category (Luo et al., 2023). All community level variables were coded in the same direction with higher values representing higher deprivation.

Table 1
Description of community-level factors.

Measures	Unit	Description	Source
Socioeconomic factors			
Neighborhood safety	%	Percent of adults who report that they feel safe in their neighborhood "all of the time" or "most of the time". (2016–2018)	Chicago Department of Public Health, Healthy Chicago Survey
Violent crime in public spaces	N	Number of reported crimes in public places (2016)	Chicago Police Department
Household poverty	%	Percent of residents in families that are in poverty (below the Federal Poverty Level) (2015–2019)	American Community Survey
Neighborhood unemployment	%	Percent of residents 16 and older in the civilian labor force who are actively seeking employment 2015–2019)	American Community Survey
Housing cost burden	%	Percentage of households that spend 50% or more of their household income on housing (2015–2019)	American Community Survey
Built environment			
Housing vacancies	%	Percent of vacant housing units (2015–2019)	American Community Survey
Low food access	%	Percent of residents who have low access to food, defined solely by distance: further than 1/2 mile from the nearest supermarket in an urban area, or further than 10 miles in a rural area (2015)	United States Department of Agriculture, Economic Research Service, Food Access Research Atlas

Source: Chicago Health Atlas. Chicago Health Atlas. Available at: https://chicagohealthatlas.org/. 2021.

3.3. Individual level factors

Individual-level, self-reported factors included: sex (men/women), age (50–64 years, 65–75), income (Less than $15,000, $15,000 and $24,999, $25,000 and $34,999 and above $34,999), education (less than high school, high school, some college, college or more), insurance (private, Medicaid, Medicare, other, uninsured) and marital status (married/partnered, single, divorced/separated and widowed).

3.4. Statistical analysis

First, we estimated descriptive statistics for selected individual-level sociodemographic characteristics. Next, we examined the association between community characteristic and CRC screening after adjusting for individual-level factors (i.e., sex, age, income, education, health insurance and marital status) that are known predictors of cancer screening (O'Malley et al., 2005; Jerant, 2004; Adams, 2004; Seeff et al., 2004; Ioannou et al., 2003; de Bosset et al., 2008; Brawarsky et al., 2003). For this analysis, we used separate generalized linear models for each community characteristic with robust standard errors to account for clustering at the community level. Finally, we used weighted quantile sum regression (WQS) to estimate the overall effect of community deprivation on individual adherence to CRC screening, both with and without adjusting for individual characteristics (Carrico et al., 2015). The WQS is a widely used mixture analysis method that considers both the association between the outcome and single explanatory variable as well as the correlation between explanatory variables (Carrico et al., 2015). This method generates a WQS index based on all seven community variables and estimates the association between WQS index and CRC screening while adjusting for individual-level variables. This method also generates a weight for each community variable that represents the contribution of each variable to the overall effect. All weights sum to 100%, and a larger weight indicates a stronger association with adherence to CRC screening. An increase of one unit in the WQS index represents a one-quartile increase in overall community deprivation. We used 500 bootstrap samples to estimate the WQS index and reserved 50% of the sample for validation (Carrico et al., 2015; Wheeler et al., 2019). Significance of the WQS index was evaluated using a 95% confidence interval for the adjusted and unadjusted odds ratios (ORs). All statistical analyses were conducted in R version 4.1.2. For the weighted quantile sum regression, we used the generalized WQS (WQS) package (Renzetti, et al., 2021).

3.5. Sensitivity analysis

At the time of this study, the USPSTF recommended routine screening for individuals of average risk between the age of 50 and 75. However, due to documented disparities in new diagnoses and survivorship, some health providers have lowered their recommended screening age to 45 for African Americans rather than 50 years (Rex et al., 2017). Therefore, in a sensitivity analysis we examined the relationship between individual and community level factors and adherence to CRC screening for African Americans between 45 and 75 years of age.

4. Results

Of the 2,836 African American participants (aged 50–75) enrolled in COMPASS from May 2013 to March 2020, 42% had ever received CRC screening (Table 2). There was more male (53%) than female (47%) participants in the study. A high percentage of African Americans in the study had low socioeconomic status, with 68% of participants reporting an annual household income of less than $15,000 and 64% of participants reporting low education (i.e., high school education or less). Most participants in the study had health insurance (89%) and over a third of participants had Medicaid. African Americans who adhere to CRC screening were older, had higher levels of socioeconomic status (i.e.,

Table 2

Sociodemographic characteristics of survey participants. (N = 2836).

	Total (n = 2836)	CRC Screening		P-Value
		Yes (n = 1180)	No (n = 1656)	
Gender				0.008
Male	1497 (52.8%)	588 (49.8%)	909 (54.9%)	
Female	1339 (47.2%)	592 (50.2%)	747 (45.1%)	
Age				<0.001
50–60	1770 (62.4%)	592 (50.2%)	1178 (71.1%)	
60+	1066 (37.6%)	588 (49.8%)	478 (28.9%)	
Marital Status				<0.001
Married	417 (14.7%)	230 (19.5%)	187 (11.3%)	
Unmarried	2419 (85.3%)	950 (80.5%)	1469 (88.7%)	
Household Income				<0.001
Less than $15,000	1935 (68.2%)	716 (60.7%)	1219 (73.6%)	
$15,000 or more	901 (31.8%)	464 (39.3%)	437 (26.4%)	
Health Insurance				<0.001
Private	461 (16.3%)	239 (20.3%)	222 (13.4%)	
Medicaid	1025 (36.1%)	429 (36.4%)	596 (36.0%)	
Medicare	412 (14.5%)	215 (18.2%)	197 (11.9%)	
Other	637 (22.5%)	228 (19.3%)	409 (24.7%)	
Uninsured	301 (10.6%)	69 (5.8%)	232 (14.0%)	
Education				<0.001
High school or less	1805 (63.6%)	655 (55.5%)	1150 (69.4%)	
Some college or more	1031 (36.4%)	525 (44.5%)	506 (30.6%)	
Neighborhood Characteristics Median (interquartile range)				
Neighborhood Insecurity	40.4 (34.0–46.5)	40.4 (29.8–45.2)	40.4 (35.2–48.0)	
Severe Housing Cost Burden	45.2 (40.7–48.9)	43.3 (40.0–48.9)	45.2 (42.0–43.3)	
Vacant Housing	18.1 (13.0–23.2)	18.1 (13.0–23.1)	18.1 (13.0–23.2)	
Unemployment	21.7 (17.7–26.0)	21.7 (17.7–26.0)	21.7 (17.7–26.0)	
Limited Food Access	13.5 (8.4–22.0)	13.5 (8.4–22.5)	13.5 (10.4–22.0)	
Household Poverty	28.8 (26.1–36.2)	28.8 (24.9–36.2)	29.5 (27.5–36.2)	
Violent Crime	1802.9 (1400.0–2244.6)	1680.2 (1354.3–2221.5)	1803.9 (1400–2244.6)	

higher income and education), and were more likely to be insured compared to those who had not been screened for CRC.

Almost half of participants lived in communities in which nearly 40% of residents reported feeling unsafe and experiencing severe housing burden. The median community unemployment rate for this study population was around 22%.

With the exception of limited food access which had a low correlation with all other community variables, the remaining community
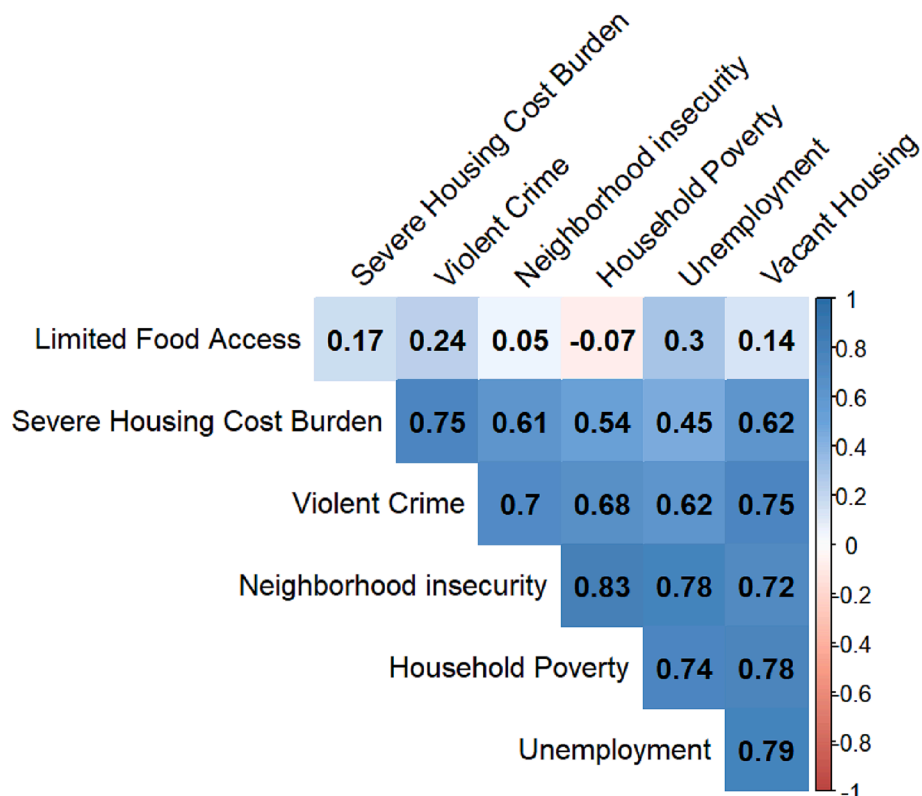

Fig. 1. Correlation of Neighborhood Characteristics.

variables were closely correlated to each other (Fig. 1), with strong correlations ranging from 0.45 to 0.83 Considering the high correlation between individual community-level variables, WQS regression were used (Carrico et al., 2015).

Logistic regressions show that all community-level characteristics had significant associations with adherence to CRC even after adjusting for individual level sociodemographic characteristics (Table 3), such that higher levels of community disadvantage was associated with lower likelihood of CRC screening.

In the adjusted WQS model, unemployment was the most important community characteristic (37.6%), followed by community insecurity (26.1%) and severe housing cost burden (16.3%). Vacant housing was the least important predictor of adherence to CRC screening with a weight of less than 0.1%. After adjusting for individual-level characteristics, a one-quartile increase in community disadvantage was associated with a lower likelihood of having a CRC screening (Table 4).

Results from the sensitivity analysis indicate that there were no qualitative differences in our main analysis, where we used an analytical sample of participants between 50 and 75 years and analysis where we restricted our sample to include participants between 45 and 75 years of age.

Table 3
Adjusted and unadjusted effects of neighborhood-level variables on colorectal cancer screening (N = 2836).

Community-Level Characteristics	Ever had colorectal cancer screening	
	OR (95% CI)	AOR (95% CI)
Severe Housing Cost Burden		
1st Quartile (lowest)	1	1
2nd Quartile	**0.63 (0.52, 0.77)**	**0.74 (0.60, 0.91)**
3rd Quartile	**0.61 (0.49, 0.77)**	**0.74 (0.58, 0.94)**
4th Quartile (highest)	**0.63 (0.51, 0.78)**	**0.75 (0.61, 0.94)**
Household Poverty		
1st Quartile (lowest)	1	1
2nd Quartile	**0.58 (0.47, 0.71)**	**0.71 (0.57, 0.89)**
3rd Quartile	**0.60 (0.49, 0.74)**	**0.69 (0.55, 0.85)**
4th Quartile (highest)	**0.72 (0.58, 0.89)**	0.85 (0.68, 1.05)
Neighborhood Unemployment		
1st Quartile (lowest)	1	1
2nd Quartile	0.86 (0.70, 1.05)	**0.80 (0.64, 0.99)**
3rd Quartile	0.85 (0.70, 1.04)	0.82 (0.67, 1.02)
4th Quartile (highest)	**0.75 (0.61, 0.94)**	**0.78 (0.62, 0.98)**
Neighborhood Insecurity		
1st Quartile (lowest)	1	1
2nd Quartile	**0.77 (0.63, 0.94)**	0.85 (0.69, 1.05)
3rd Quartile	**0.58 (0.46, 0.72)**	**0.64 (0.50, 0.80)**
4th Quartile (highest)	**0.68 (0.56, 0.84)**	**0.79 (0.63, 0.98)**
Violent Crime		
1st Quartile (lowest)	1	1
2nd Quartile	**0.75 (0.61, 0.91)**	**0.79 (0.64, 0.98)**
3rd Quartile	**0.74 (0.60, 0.90)**	0.90 (0.72, 1.11)
4th Quartile (highest)	**0.66 (0.53, 0.83)**	**0.75 (0.59, 0.94)**
Vacant Housing		
1st Quartile (lowest)	1	1
2nd Quartile	**0.76 (0.62, 0.94)**	**0.72 (0.58, 0.90)**
3rd Quartile	**0.76 (0.63, 0.93)**	**0.81 (0.66, 0.99)**
4th Quartile (highest)	**0.75 (0.60, 0.92)**	**0.76 (0.61, 0.95)**
Limited Food Access		
1st Quartile (lowest)	1	1
2nd Quartile	**0.70 (0.57, 0.86)**	**0.69 (0.55, 0.86)**
3rd Quartile	**0.79 (0.64, 0.97)**	0.83 (0.66, 1.03)
4th Quartile (highest)	0.87 (0.70, 1.07)	**0.80 (0.64, 0.99)**

Table 4
The adjusted and unadjusted effect of neighborhood environment on colorectal cancer screening and contribution weight of each neighborhood variable in the weighted quantile sum (WQS) regression models. (N = 2836).

	Odds Ratio (95% Confidence Interval)	
	Model 1 (Unadjusted)	Model 2 (Adjusted)[2]
WQS index[1]	0.79 (0.71, 0.88)	0.84 (0.75, 0.94)
	Weights of Neighborhood Characteristics	
Unemployment	28.5%	37.6%
Severe Housing Cost Burden	24.3%	16.3%
Neighborhood Insecurity	22.1%	26.1%
Household Poverty	20.2%	13.9%
Violent Crime	3.8%	3.2%
Limited Food Access	0.9%	2.8%
Vacant Housing	0.0%	0.0%

[1] The WQS index is a weighted index of the seven neighborhood disadvantage variables. The odds ratio should be interpreted as the effect of increasing overall neighborhood disadvantage by one quartile.

[2] Adjusted for individual gender, age, marital status, household income, health insurance, and education.

5. Discussion

This study, among predominately-low income African Americans in Chicago, examined the influence of community-level factors on adherence to CRC screening. When analyzing all community characteristics as a mixture, overall community disadvantage was associated with less adherence to CRC screening even after controlling for individual-level socioeconomic factors. This indicates that community disadvantage negatively impacts African Americans' adherence to CRC screening independent of their individual-level socioeconomic status. Results from this study are consistent with other studies that find that individuals living in communities with higher levels of community disadvantage are less likely to adhere to CRC screening (Kurani et al., 2020; Calo et al., 2015; Danos et al., 2018; Fukuda et al., 2005; Lian et al., 2008; Buehler et al., 2019; Beyer et al., 2016; Mayhand et al., 2021; Shariff-Marco, 2013; Schootman, 2006). A recent study among African Americans in Philadelphia, failed to find a significant association between community census tract measures (e.g. poverty level, violent crimes, community perceived as safe) after adjusting for individual-level factors (Buehler et al., 2019). Difference in results between our study and the previously mentioned may result from how the social environment was defined. In our study we use community-level indicators which are more likely to coincide with meaningful definitions of community and whose characteristics may be more relevant to specific health outcomes, as oppose to census tracts (used in Buehler and colleague's study) which are rough proxies for "neighborhood" or "community" areas (Diez Roux, 2001). Discrepancies in result may also be related to differences in the study sample. The Buehler and colleague's study (Buehler et al., 2019) included African Americans who had attend at least one doctor's visit in 2016. Therefore, it is possible that the study population in this study may have included individuals that prioritize health and healthcare use and may not be generalizable to all segments of the population.

Our analysis of multiple community characteristics, identified unemployment, community insecurity and severe housing burden as the largest contributor to overall community disadvantage. Unemployment (38%) and severe hosing burden (16%) accounted for over 50% of the overall impact of community disadvantage on colorectal cancer screening. Previous studies have found that individuals living in in areas with low socioeconomic status (i.e., high unemployment rates, low community income, low education, high levels of community deprivation) are less likely to adhere to screening guidelines (Kurani et al., 2020; Fukuda et al., 2005; Mayhand et al., 2021; McCaffery et al., 2002). Individuals living in areas with low socioeconomic status may be less inclined to adhere to CRC screening guidelines due to competing

demands and life chaos that arise from a reduction in unmet social needs (Gurewich et al., 2020). Communities with poor socioeconomic conditions may function as a source of stress for community residents with unmet social needs, precluding them from engaging in health behaviors such as cancer screening (Illinois Department of Public Health, 2022; Beyer et al., 2016). Moreover, experiencing unmet social needs may negatively impacts a person's mental health which in turn may not only impact adherence to CRC screening but also affect the communities general health and well-being (Gurewich et al., 2020).

African Americans living in communities with high rates of community insecurity were also less likely to adhere to CRC screening. In fact, community insecurity, accounted for 26% of the overall impact of community disadvantage on colorectal cancer screening respectively. It is possible that living in communities characterized by high rates of crime and where residents feel unsafe can contribute to a sense of powerlessness among community members who may feel that their health is beyond their control (Beyer et al., 2016; Gurewich et al., 2020). Moreover, individuals living in unsafe communities with high rates of crime may encounter obstacles developing supportive community relationships that are conducive to better health and a higher likelihood of cancer screening (Beyer et al., 2016). This is consistent with a previous study that suggest that environmental problems such high rates of crime is associated with lower adherence to CRC screening (Beyer et al., 2016).

Individuals living in marginalized communities in the South Side of Chicago experience high levels of community disadvantage characterized by limited resources such as high-quality healthcare. In fact, community members in the South Side of the city are more likely to be uninsured with some communities reporting uninsured rates as low at 36% (Cohen, 2016). Living in marginalized neighborhoods with limited access to health services has been associated with lower cancer screening rates and lower quality services which can lead to undiagnosed cancer cases (Hirschman et al., 2007). Future studies, need to examine the impact of the social and physical environment on the quality of cancer screening services received by marginalized populations.

Results from this study indicate that successful efforts to improve CRC screening rates should prioritize individuals living in communities with high rates of insecurity and low socioeconomic status. A systematic review focused on interventions that have leveraged on social determinants of health to improve cancer screening, revealed that interventions generally included transportations assistance for appointments, reduced transportation burden by mailing home screening kits, reduced out of pocket cost for screening, child care assistance, patient navigation, language translation services and cash incentives as a means to improve adherence to cancer screening (Mohan and Chattopadhyay, 2020). Although this strategies are important, this approaches are not sufficient to address social determinates such community crime and poverty, which are fundamental drivers of persistent health disparities (Thornton et al., 2016). There is a crucial need for additional research that focuses on implementing social determinates of health into cancer screening interventions to reduce health disparities among disadvantage communities.

6. Strengths and limitations

This study has several strengths. First, data from this study comes from COMPASS, a large cohort study that oversamples disadvantage groups in Chicago and includes detailed information on a wide range of health outcomes. Second, we used community-level indicators which are more likely to coincide with meaningful definitions of community as oppose to census tracts which are rough proxies for "neighborhood" or "community" areas, commonly used in multilevel analysis (Diez Roux, 2001). Third, this paper included seven community characteristics that have previously been found to predict CRC screening, using advance analytical methodologies that enable us to not only evaluate their combine effect, but also to identify the contribution of each

characteristic (Luo et al., 20232023).

There are also important limitations to be considered in this study. First, due to the cross-sectional nature of the data, we cannot draw causal conclusions about the relationships between the primary study variables. However, it is unlikely that adherence to CRC screening behavior would influence the individual and community level variables investigated here. Second, we were unable to assess the specific type of CRC screening (e.g. colonoscopy, sigmoidoscopy) and instead used a less detailed question that examine if participant had ever utilized CRC screening. This may have introduced bias to our study as participants who indicated adhering to CRC screening, may not necessary be up to date with CRC screening guidelines. However, in this study we restricted our sample to include participants between the age of 50 and 75, which coincides with the age requirements for CRC cancer screening in the recommended guidelines (Bibbins-Domingo et al., 2016; Rex et al., 2017). Third, although, the models in this study were adjusted for potential confounders, residual confounding may have biased the results. For instance, we were unable to adjust our models for factors that have previously been found to influence cancer screening at the individual-level, such as attitudes, believes and social norms related to CRC screening utilization. Finally, although our sample included a large number of African Americans in Chicago, results may not be generalizable to African Americans in the US. Results may be comparable to settings similar to Chicago that are racially and geographically segregated.

7. Conclusions

Timely screening and early detection of colorectal cancer may improve cancer related racial disparities (Shapiro et al., 2008). However, efforts to increase CRC screening adherence has focused largely on educational messaging about the needs for CRC combined with free or low cost screening opportunities (Beyer et al., 2016), and have not address the social determinants of health such as community context. Public health programs that seek to increase rates of CRC screening, will need to prioritize community interventions that address social determinant of health (i.e., contextual community variables), in order to ameliorate disparities among African Americans and other undeserved population.

Author contribution

PL conceived of the research, led the writing of the manuscript and critically revised the manuscript **FR** conceived of the research and critically revised the manuscript. **AP** Conducted the data analysis and supported the drafting of the manuscript **BA, MK** conceived of the research and critically revised the manuscript **JL, SS, PZ, AC** Supported the data analysis and the description of study methods **LS, LS, SK, HL, HA,** are experts in the research topic and critically revised the final version of the manuscript **KEK** conceived of the research question and critically revised all versions of the manuscript.

All authors have reviewed the submitted manuscript and approve the manuscript for submission.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

References

Adams, E.K., et al., 2004. Colorectal cancer screening, 1997–1999: role of income, insurance and policy. Prev. Med. 38 (5), 551–557.

Aschebrook-Kilfoy, B., Kibriya, M.G., Jasmine, F., Stepniak, L., Gopalakrishnan, R., Craver, A., Zakin, P., Tasmin, S., Kim, K.E., Goss, K.H., List, M., LeBeau, M., Ahsan, H., 2020. Cohort profile: the ChicagO Multiethnic Prevention and Surveillance Study (COMPASS). BMJ Open 10 (9), e038481.

Berry, J., Bumpers, K., Ogunlade, V., Glover, R., Davis, S., Counts-Spriggs, M., Kauh, J., Flowers, C., 2009. Examining racial disparities in colorectal cancer care. J. Psychosoc. Oncol. 27 (1), 59–83.

Beyer, K.M.M., Malecki, K.M., Hoormann, K.A., Szabo, A., Nattinger, A.B., 2016. Perceived neighborhood quality and cancer screening behavior: evidence from the survey of the health of Wisconsin. J. Community Health 41 (1), 134–137.

Bibbins-Domingo, K., Grossman, D.C., Curry, S.J., Davidson, K.W., Epling, J.W., García, F.A.R., Gillman, M.W., Harper, D.M., Kemper, A.R., Krist, A.H., Kurth, A.E., Landefeld, C.S., Mangione, C.M., Owens, D.K., Phillips, W.R., Phipps, M.G., Pignone, M.P., Siu, A.L., 2016. Screening for colorectal cancer: US Preventive Services Task Force recommendation statement. J. Am. Med. Assoc. 315 (23), 2564.

Brawarsky, P., Brooks, D., Mucci, L., 2003. Correlates of colorectal cancer testing in Massachusetts men and women. Prev. Med. 36 (6), 659–668.

Buehler, J.W., Castro, J.C., Cohen, S., Zhao, Y., Melly, S., Moore, K., 2019. Personal and neighborhood attributes associated with cervical and colorectal cancer screening in an urban African American population. Prev. Chronic Dis. 16.

Calo, W.A., Vernon, S.W., Lairson, D.R., Linder, S.H., 2015. Associations between contextual factors and colorectal cancer screening in a racially and ethnically diverse population in Texas. Cancer Epidemiol. 39 (6), 798–804.

Carrico, C., Gennings, C., Wheeler, D.C., Factor-Litvak, P., 2015. Characterization of weighted quantile sum regression for highly correlated data in a risk analysis setting. J. Agric. Biol. Environ. Stat. 20 (1), 100–120.

Chicago Health Atlas. Chicago Health Atlas. Available at: https://chicagohealthatlas.org/. 2021.

City Tech Collaborative, Case Study: Chicago Health Atlas. Available at: *https://www.citytech.org/chicago-health-atlas.* 2021.

Cohen, S., et al., 2016. Healthy Chicago 2.0 Community Health Assessment: Informing Eff orts to Achieve Health Equity. Chicago Department of Public Health.

Danos, D.M., et al., Neighborhood disadvantage and racial disparities in colorectal cancer incidence: a population-based study in Louisiana. Ann. Epidemiol., 2018. **28** (5): p. 316-321. e2.

de Bosset, V., et al., Health insurance–related disparities in colorectal cancer screening in Virginia. Cancer Epidemiology and Prevention Biomarkers, 2008. **17**(4): p. 834-837.

Diez Roux, A.V., 2001. Investigating neighborhood and area effects on health. Am. J. Public Health 91 (11), 1783–1789.

Estime, S., Williams, B., 2021. Systemic Racism in America and the Call to Action. Am. J. Bioeth. 21 (2), 41–43.

Fukuda, Y., Nakamura, K., Takano, T., 2005. Reduced likelihood of cancer screening among women in urban areas and with low socio-economic status: a multilevel analysis in Japan. Public Health 119 (10), 875–884.

Gurewich, D., Garg, A., Kressin, N.R., 2020. Addressing social determinants of health within healthcare delivery systems: a framework to ground and inform health outcomes. J. Gen. Intern. Med. 35 (5), 1571–1575.

Halbert, C.H., Melvin, C., Briggs, V., Delmoor, E., Rice, L.J., Lynch, C., Jefferson, M., Johnson, J.C., 2016. Neighborhood satisfaction and colorectal cancer screening in a community sample of African Americans. J. Community Health 41 (1), 38–45.

Health, W.C.o.S.D.o. and W.H. Organization, Closing the gap in a generation: health equity through action on the social determinants of health: Commission on Social Determinants of Health final report. 2008: World Health Organization.

Hirschman, J., Whitman, S., Ansell, D., 2007. The black: white disparity in breast cancer mortality: the example of Chicago. Cancer Causes Control 18 (3), 323–333.

Illinois Department of Public Health, Behavioral Risk Factor Surveillance System (2006-2009), Chicago Department of Public Health. Healthy Chicago Survey (2014-2016).

Illinois Department of Public Health. 2022-2027 Illinois Comprehensive Cancer Control Plan. Health Equity and Health Disparities. *https://dph.illinois.gov/topics-services/diseases-and-conditions/cancer/2022-2027-illinois-comprehensive-cancer-control-plan/health-equity-health-disparities.html.* 2022.

National Cancer Institute, Cancer Trends Progress report. Available at: *https://progressreport.cancer.gov/detection/.* 2020.

Ioannou, G.N., Chapko, M.K., Dominitz, J.A., 2003. Predictors of colorectal cancer screening participation in the United States. Am. J. Gastroenterol. 98 (9), 2082–2091.

Jerant, A.F., et al., 2004. Age-related disparities in cancer screening: analysis of 2001 Behavioral Risk Factor Surveillance System data. Ann. Family Med. 2 (5), 481–487.

Joseph, D.A., King, J.B., Dowling, N.F., Thomas, C.C., Richardson, L.C., 2020. Vital signs: colorectal cancer screening test use—United States, 2018. Morb. Mortal. Wkly Rep. 69 (10), 253–259.

Kurani, S.S., McCoy, R.G., Lampman, M.A., Doubeni, C.A., Finney Rutten, L.J., Inselman, J.W., Giblon, R.E., Bunkers, K.S., Stroebel, R.J., Rushlow, D., Chawla, S.S., Shah, N.D., 2020. Association of neighborhood measures of social determinants of health with breast, cervical, and colorectal cancer screening rates in the US Midwest. JAMA Netw. Open 3 (3), e200618.

Leader, A.E., Michael, Y.L., 2013. The association between neighborhood social capital and cancer screening. Am. J. Health Behav. 37 (5), 683–692.

Lian, M., Schootman, M., Yun, S., 2008. Geographic variation and effect of area-level poverty rate on colorectal cancer screening. BMC Public Health 8 (1), 1–16.

Lofters, A.K., Schuler, A., Slater, M., Baxter, N.N., Persaud, N., Pinto, A.D., Kucharski, E., Davie, S., Nisenbaum, R., Kiran, T., 2017. Using self-reported data on the social determinants of health in primary care to identify cancer screening disparities: opportunities and challenges. BMC Fam. Pract. 18 (1).

Luo, J., Kibriya, M.G., Shah, S., Craver, A., De La Cruz, S., King, J., Olopade, C.O., Kim, K., Ahsan, H., Pinto, J., Aschebrook-Kilfoy, B., 2023. The Impact of Neighborhood Disadvantage on Asthma Prevalence in a Predominantly African American Chicago-based Cohort. Am. J. Epidemiol. 192 (4), 549–559.

Masi, C.M., Gehlert, S., 2009. Perceptions of breast cancer treatment among African-American women and men: implications for interventions. J. Gen. Intern. Med. 24 (3), 408–414.

Mayhand, K.N., Handorf, E.A., Ortiz, A.G., Gonzalez, E.T., Devlin, A., Sorice, K.A., Esnaola, N., Fisher, S., Lynch, S.M., 2021. Effect of Neighborhood and Individual-Level Socioeconomic Factors on Colorectal Cancer Screening Adherence. Int. J. Environ. Res. Public Health 18 (9), 4398.

McCaffery, K., Wardle, J., Nadel, M., Atkin, W., 2002. Socioeconomic variation in participation in colorectal cancer screening. J. Med. Screen. 9 (3), 104–108.

Mohan, G., Chattopadhyay, S., 2020. Cost-effectiveness of leveraging social determinants of health to improve breast, cervical, and colorectal cancer screening: a systematic review. JAMA Oncol. 6 (9), 1434–1444.

Novara, M. and A. Khare, Two Extremes of Residential Segregation: Chicago's Separate Worlds & Policy Strategies for Integration. Proceedings of A Shared Future: Fostering Communities of Inclusion in an Era of Inequality, 2017.

O'Malley, A.S., Forrest, C.B., Feng, S., Mandelblatt, J., 2005. Disparities despite coverage: gaps in colorectal cancer screening among Medicare beneficiaries. Arch. Intern. Med. 165 (18), 2129.

Healthy People 2030. U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Retrieved September 1, 2022, from *https://health.gov/healthypeople/objectives-and-data/social-determinants-health.* 2023.

Renzetti, S., et al., Package 'gWQS'. 2021.

Rex, D.K., Boland, C.R., Dominitz, J.A., Giardiello, F.M., Johnson, D.A., Kaltenbach, T., Levin, T.R., Lieberman, D., Robertson, D.J., 2017. Colorectal cancer screening: recommendations for physicians and patients from the US Multi-Society Task Force on Colorectal Cancer. Gastroenterology 153 (1), 307–323.

Richards, R.J., Reker, D.M., 2002. Racial differences in use of colonoscopy, sigmoidoscopy, and barium enema in Medicare beneficiaries. Dig. Dis. Sci. 47 (12), 2715–2719.

Robillard, A.G., Larkey, L., 2009. Health disadvantages in colorectal cancer screening among African Americans: Considering the cultural context of narrative health promotion. J. Health Care Poor Underserved 20 (2), 102–119.

Schootman, M., et al., 2006. Effect of area poverty rate on cancer screening across US communities. J. Epidemiol. Community Health 60 (3), 202–207.

Seeff, L.C., Nadel, M.R., Klabunde, C.N., Thompson, T., Shapiro, J.A., Vernon, S.W., Coates, R.J., 2004. Patterns and predictors of colorectal cancer test use in the adult US population. Cancer: Interdisc. Int. J. Am. Cancer Soc. 100 (10), 2093–2103.

Shapiro, J.A., et al., Colorectal cancer test use from the 2005 National Health Interview Survey. Cancer Epidemiology and Prevention Biomarkers, 2008. **17**(7): p. 1623-1630.

Shariff-Marco, S., et al., 2013. Multilevel predictors of colorectal cancer screening use in California. Am. J. Manag. Care 19 (3), 205.

Siegel, R.L., et al., Colorectal cancer statistics, 2017. CA: A Cancer J. Clinic., 2017. **67**(3): p. 177-193.

Siegel, R.L., et al., Colorectal cancer statistics, 2020. CA: A Cancer J. Clinic., 2020. **70**(3): p. 145-164.

Siegel, R.L., Miller, K.D., Jemal, A., 2017. Colorectal cancer mortality rates in adults aged 20 to 54 years in the United States, 1970–2014. J. Am. Med. Assoc. 318 (6), 572–574.

Siegel, R.L., Fedewa, S.A., Anderson, W.F., Miller, K.D., Ma, J., Rosenberg, P.S., Jemal, A., 2017. Colorectal cancer incidence patterns in the United States, 1974–2013. JNCI: J. Natl. Cancer Inst. 109 (8).

Thornton, R.L.J., Glover, C.M., Cené, C.W., Glik, D.C., Henderson, J.A., Williams, D.R., 2016. Evaluating strategies for reducing health disparities by addressing the social determinants of health. Health Aff. 35 (8), 1416–1423.

Wheeler, D.C., Jones, R.M., Schootman, M., Nelson, E.J., 2019. Explaining variation in elevated blood lead levels among children in Minnesota using neighborhood socioeconomic variables. Sci. Total Environ. 650, 970–977.

Whitman, S., Shah, A., Benjamins, M., 2011. Urban health: combating disparities with local data. Oxford University Press.