(Article begins on next page)

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Cancer incidence disparities in Upper Manhattan New York City neighborhoods: the role of race/ethnicity, socioeconomic status, and known risk factors

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Abstract

OBJECTIVE—We examined effects of race/ethnicity and neighborhood, a proxy of socioeconomic status, on cancer incidence in New York City neighborhoods: East Harlem (EH), Central Harlem (CH), and Upper East Side (UES).

METHODS—In this ecological study, Community Health Survey (CHS) data (2002–2006) and New York State Cancer Registry incidence data (2007–2011) were stratified by gender, age, race/ethnicity, and neighborhood. Logistic regression models were fitted to each cancer incidence rate with race/ethnicity, neighborhood, and CHS-derived risk factors as predictor variables.

RESULTS—Neighborhood was significantly associated with all cancers and 14 out of 25 major cancers. EH and CH residence conferred higher risk of all cancers compared to UES (OR=1.34; CI: 1.07, 1.68 and OR=1.39; CI: 1.12, 1.72, respectively). Prevalence of diabetes and tobacco smoking were the largest contributors to high cancer rates.

CONCLUSIONS—Despite juxtaposition and similar proximity to medical centers, cancer incidence disparities persist among EH, CH, and UES neighborhoods. Targeted, neighborhood-specific outreach may aid in reducing cancer incidence rates.

Keywords

neoplasms; incidence; New York City; healthcare disparities; socioeconomic factors

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INTRODUCTION

New York City (NYC) is a highly populated, geographically concentrated metropolitan area with large racial/ethnic and socioeconomic status (SES) diversity, making it suitable for investigating racial/ethnic and SES disparities in cancer incidence and determinants. However, few studies have attempted to systematically disentangle the effect of SES and race/ethnicity on cancer risk (Islami et al. 2013, Klein Rosenthal, Kinney, and Metzger 2014).

Most prior studies on cancer disparities in NYC as well as other locations have focused on race/ethnicity (Whitman et al. 2011, Hirschman, Whitman, and Ansell 2007, Jandorf et al. 2008, Mayberry et al. 1995, Cruz et al. 2007). For studies that attempted to disentangle effects of SES disparities as well as race/ethnicity, only single cancer sites have been investigated to date (Richards et al. 2011, McCarthy et al. 2010, Whitman et al. 2011). Different population studies observed that living in SES-deprived neighborhoods was independently associated with lifestyle health risks, such as excess body weight (Janssen et al. 2006, Mobley et al. 2006), tobacco smoking (Hanibuchi et al. 2014), lower physical activity (van Lenthe, Brug, and Mackenbach 2005), increased stress (Cheng et al. 2014), and lower fruit and vegetable consumption (Giskes et al. 2006, Dubowitz et al. 2008). Cultural and social differences influence collective behaviors as well as individual psychological and physiological states. Systemic inflammation and tobacco smoking were significantly associated with low SES populations compared to nearby high SES populations (Hostinar et al. 2014, Levin et al. 2014).

Using a range of state and local data sources, we investigated the association between both race/ethnicity and neighborhood of residence in NYC—as proxy for SES— and incidence of all cancers combined as well as major specific cancers. Analysis was restricted to three neighborhoods: Upper East Side (UES), Central Harlem (CH), and East Harlem (EH). Although these neighborhoods are in similar proximity to medical centers, they are characterized by extreme differences in ethnic/racial composition, SES (Buchholz N. 2012), and cancer incidence rates.

METHODS

The study was conducted in three neighborhoods of NYC: UES, CH and EH (Figure S1). Selected socio-demographic characteristics of the three neighborhoods are listed in Table 2.

Neighborhood boundaries

United Hospital Fund (UHF) neighborhoods differentiated NYC neighborhoods. UHF neighborhoods are administrative boundaries defined by several adjoining zip code areas with similar characteristics, designated to approximate NYC Community Planning Districts ((NYCDOHMH) 2011). The places and populations contained within UHF areas often share common histories, built environments, and SES characteristics, and their use in ecological analysis is a scale of spatial disaggregation commonly used by each of the institutions from which data were obtained: the New York State Cancer Registry (NYSCR), the NYC

Department of Mental Health and Hygiene, and previous NYC-based ecological studies (Klein Rosenthal, Kinney, and Metzger 2014).

Incidence data

Cancer incidence data for the three UHF neighborhoods were obtained from the NYSCR. Incidence counts for each cancer were aggregated for 2007–2011 by neighborhood, age group, race (non-Hispanic white, non-Hispanic black, and Hispanic of all races), and gender. A total of 26 major cancers defined according to the International Classification of Diseases for Oncology (ICD-O-3) categories (SEER 2012) were included: all invasive malignant tumors, oral cavity and pharynx, esophageal, stomach, colorectal, colon, rectum and rectosigmoid, liver, pancreas, larynx, lung, melanoma of the skin, female breast, cervix uteri, corpus uterus and uterus NOS, ovary, prostate, testis, urinary bladder including *in situ*, kidney and renal pelvis, brain and other nervous system, thyroid, Hodgkin lymphoma, non-Hodgkin lymphoma, myeloma, and leukemia. To maintain stable cancer incidence rates across aggregated strata, two age groups were included: 35–64 years and greater or equal to 65 years except for all malignant neoplasms as well as lung, breast, prostate, and colorectal cancers, for which we used 5 age groups: 35–44, 45–54, 55–64, 65–74, and 75+.

The age-specific incidence rates were calculated by dividing the number of new cases by the NYC Census population for 5 years (2007–2011), obtained from the NYC Department of Mental Health and Hygiene Office of Vital Statistics, for each gender-age group, neighborhood and race/ethnicity stratum. Cancer incidence rates were age-standardized using the 2000 US population standard.

Risk and protective factor data

Individual data on exposures which included demographic, health, and lifestyle cancer risk factors from 2002–2006 were obtained from the NYC Community Health Survey (CHS). The CHS is an annual, cross-sectional telephone survey using a stratified random-digit dialing sample design to ensure adequate sample per UHF area conducted by the Department of Health and Mental Hygiene in all NYC neighborhoods (Table S1). CHS data and cancer incidence rates were stratified by gender, UHF neighborhood, age group, and race/ethnicity. A total of 2974 individuals with survey responses from 2002–2006 comprised the CHS dataset, of whom 170 were excluded due to missing age data and most other variables. Each stratum count was converted to prevalence data for dichotomous and categorical variables as well as means for continuous variables.

Categorical variables of cancer risk factors that were obtained from CHS included: presence of a primary care physician, tobacco smoking status (current, former, never), exercise in the last 30 days, presence of co-morbidities (receiving diagnosis by a health care provider of diabetes, high blood pressure, or high cholesterol, respectively), binge drinking (five or more alcoholic drinks on one occasion in the past 30 days), asthma attack in the past 12 months, foreign born, screening history (receiving mammogram in past 2 years, PAP smear in past 3 years, and ever receiving colonoscopy), recreational needle use, ever receiving HIV test, and HIV test in the past 12 months.

Means were calculated by stratum for continuous variables including body-mass index (BMI) based on self-reported height and weight, household poverty level based on zip code poverty percentage (<10%, 10–20%, 20–30%, >30%), fruit and vegetable intake (none, 1–4 servings/day, 5+ servings/day), self-assessed health (excellent, very good, good, fair, poor), and number of sexual partners in the past 12 months (none, one, two, three or more). Means for categorical responses were obtained after ordinal re-labeling: fruit and vegetable servings per day as 0=none, 2.5 for 1–4, and 7.5 for > 5; general health as 1=poor, 2=fair, 3=good, 4=very good, and 5=excellent; number of sex partners as 1=one partner, 2=two partners, and 4.5 for ≥3 partners.

Statistical analysis

Specific cancer incidence (2007–2011) was stratified by UHF neighborhood, age category (35–44, 45–54, 55–64, 65–74, and ≥75 years), gender, and race/ethnicity (white, black, and Hispanic). Basic models included cancer incidence as the outcome variable and the aforementioned four fixed independent predictor covariates. Logistic regression analysis determined effect estimates for sex, age group, race, and neighborhood covariates for all cancers and specific cancer incidence rates. Odds ratios (ORs) and 95% confidence intervals (CIs) were obtained using the youngest age group and males as reference categories.

Significant differences in CHS risk factor means and proportions between the three neighborhoods were measured using ANOVA and chi-square tests, respectively. An alternative set of logistic regression models were fitted and included the four covariates from the basic models plus CHS-obtained risk and protective factors as modifiable predictors. Stepwise logistic regression techniques were used to fit CHS-derived factors in the model, using a P=0.10 threshold.

The log-likelihood ratio differences between basic models and fitted alternative models were calculated for all cancers and specific cancers. Alternative models were retained if log-likelihood ratio differences had a P-value of 0.05. Incidence rates were age-standardized for ≥35 years old using the 2000 US population standard for the purposes of this paper. All statistical analyses were conducted using SAS® software, Version 9.4.

RESULTS

A total of 12, 251 cancer cases were included in this study. The distribution and incidence rates of all cancers combined and the commonest cancers for the UES, EH, and CH are shown in Table 1.

Risk and Protective Factors

Selected risk and protective factor differences between UES, CH, and EH are presented in Table 2. Smoking status and cigarettes per day were the most frequently significant CHS risk factors in the fitted logistic regression models and were positively associated with 10 out of 26 cancers, including all cancers (OR=2.33; 95% CI: 1.88, 2.89). Diabetes prevalence (OR=1.45; 95% CI: 1.19, 1.78), number of sexual partners (OR=1.24; 95% CI: 1.13, 1.36), neighborhood poverty (OR=0.83; 95% CI: 0.75, 0.93), and college graduation (OR=0.78; 95% CI: 0.63, 0.98), were associated with incidence of all cancers combined.

Additional common CHS variables that were significantly associated with cancer outcomes include fruit and vegetable consumption (breast, oral, liver, kidney cancers, as well as leukemia), BMI (colorectal, liver, uterine, ovarian, and lung cancers), graduating college (colon cancer, myeloma), and neighborhood poverty level (brain and laryngeal cancers, as well as leukemia).

Cancer Incidence, 2007 to 2011

EH black men have the highest incidence rates (aged ≥35 years) for all cancers combined (Figure 1). Compared to UES, incidence rates for all cancers combined are highest for CH blacks and whites for both genders. For blacks, cancer incidence is higher in EH and CH compared to UES. Conversely, for Hispanics, cancer incidence is higher in UES versus EH and CH. UES Hispanic men have higher cancer incidence than UES white men, although confidence intervals between these two subgroups overlap. Women have higher all combined cancer incidence than males in UES and EH white subgroups. This is due to the higher breast cancer incidence in UES white women of 336 (95% CI: 260, 356) while prostate cancer in UES white men is comparatively lower at 280 (95% CI: 261, 300). Inequalities among the same cancers are also seen for EH whites: 299 (95% CI: 98, 388) for breast cancer among women and 186 (95% CI: 117, 255) for prostate cancer among men. Standardized incidence rates for all ages and by specific major cancer sites among UHF neighborhoods are displayed in Figure S1.

After risk factors adjustment, EH or CH residency were significantly associated with 34% and 39% higher odds incidence for all cancers combined, respectively, compared to UES. White race was associated with significantly higher incidence of all cancers compared to both other racial/ethnic groups (Table 3).

Two of the commonest cancers, lung and colorectal cancer, were significantly influenced by neighborhood with 27% higher risk of lung cancer incidence in EH and 38% higher risk of colorectal cancer in CH after risk factor adjustment.

Other neighborhood-influenced cancers were esophageal, kidney, brain, and non-Hodgkin lymphoma, which were higher in the UES than CH and EH. Cancers significantly associated with both neighborhood and race/ethnicity were oral, colon, liver, laryngeal, cervix, and bladder cancer in addition to melanoma and leukemia. Except for bladder cancer, black race was also associated with higher incidence. Incidence rates for melanoma and leukemia were also lower in blacks than whites. UES residence compared to CH and EH was associated with a higher incidence for melanoma, leukemia, and laryngeal cancer. EH and/or CH residency were significantly associated with a higher incidence of oral and colon cancers. Odds of cervical cancer were 2.3-times higher for EH residents compared to UES while the odds of liver cancer were 2.9-times higher in CH compared to UES.

Cancers of the prostate, stomach, pancreas, uterus, testis, myelomas, and thyroid were significantly influenced by race/ethnicity, but not neighborhood. Blacks had > 2-times the risk for cancers of the oral cavity, stomach, colon, liver, larynx, myeloma, cervix, and endometrium. Hispanic ethnicity was associated with a higher incidence of myeloma and stomach cancer. Prostate, lung, and pancreatic cancer had a higher incidence in blacks compared to whites. While whites had a 35% significantly higher risk for breast cancer incidence compared to blacks prior to risk and protective variable adjustment, the association became statistically insignificant after adjustment for diet, insurance status, tobacco smoking, mammography, and exercise.

No significant associations with either race/ethnicity or neighborhood were observed for cancers of the rectum, ovary as well as Hodgkin's lymphoma after adjustments for risk and protective factors.

DISCUSSION

Cancer incidence disparities remains among three neighborhoods, EH, CH, and UES, in Upper Manhattan despite contiguity. Neighborhood was a statistically significant predictor of incidence for all cancers combined, as well as 14 out of 25 specific cancers in this study. In 10 out of these 14 cancers, including all cancers combined, the association of neighborhood did not become significant until after risk factors were included in the models, underscoring the pivotal role of modifiable risk factors in cancer development.

Lung cancer incidence rates were reflective of tobacco smoking prevalence among neighborhoods; more tobacco smokers resided in EH and CH from 2002–2006 and lung cancer incidence is concurrently higher in these neighborhoods. Likewise, breast cancer associations did not change after risk factor adjustments, coinciding with the fact that a similar proportion of women had mammograms in the past 2 years across all three neighborhoods (P=0.43) and three races (P=0.44). Similarly, for colorectal cancer, the significant positive association with black race was diminished after adjustment for presence of a primary care physician. Although only 41% of CHS-takers responded as to whether they had ever received colonoscopy, the CHS proportion of those who reported who affirmatively self-reported ever having had a colonoscopy is similar to what has been found in a previous New York City study in which this data was independently collected (69% in this study vs. 64% as reported by the Community Health Survey) (Crookes et al. 2014). Because the consistency of colonoscopy screening every 10 years had not been inquired as part of CHSs, the presence of a primary care physician may have served as a proxy for colorectal cancer screening (Crawford MJ 2004) and follow-up after screening, which was negatively associated with cancer incidence in our study.

Despite adjustment for neighborhood and risk factors, significant racial/ethnic association persisted for certain cancer types. Black men have higher incidence of prostate cancer, although contributions of specific dietary and modifiable factors associated with SES levels have been inconsistent (Ahn et al. 2008, Tuohimaa et al. 2004, Ahonen et al. 2000) and unable to account for wide racial/ethnic disparities (Cheng et al. 2009, Hankey et al. 1999). Stomach cancer (Siegel, Naishadham, and Jemal 2012, Siegel et al. 2014), pancreatic cancer (Howlader N, Enewold et al. 2014), and myeloma (Howlader N, Gebregziabher et al. 2006) have been shown to be higher in non-white populations despite SES adjustments, although low SES indicators such as lower education and income levels are also associated with myeloma (Baris et al. 2000) and pancreatic cancer incidence (Standop et al. 2012). Although this study found significant associations between increased pancreatic cancer and increased number of sex partners, the latter variable is correlated to other factors which have been demonstrated to be associated with pancreatic cancer such as current smoking (Lynch et al. 2009) (ρ=0.35; *P*=0.04) and alcohol binge drinking (Michaud et al. 2010, Lucenteforte et al. 2012)(ρ=0.74; *P*<0.001), suggesting potential residual confounding. Despite this, the adjustment was inadequate in explaining the positive association between black race/ ethnicity and pancreatic cancer incidence. Similarly, higher incidence of thyroid and testicular cancer in whites compared to blacks is consistent with previous studies (Howlader N, Gajendran, Nguyen, and Ellison 2005). Although whites are genetically predisposed to thyroid cancer (Reitzel et al. 2014, Zhuang et al. 2014), higher rates among whites are also a consequence of over-diagnosis since thyroid cancer is associated with rising SES among blacks and Hispanics (Reitzel et al. 2014).

A limitation of the study is that true risk and protective factor adjustments may not have been complete due to a lack of adequate variable measurements in the CHS. The CHS survey did not gather information on exposure to environmental carcinogens (e.g., radiation, occupational agents, air pollution), reproductive factors, family cancer history, other genetic predisposition factors, HIV status, and infectious disease (e.g., Human papillomavirus).

CHS data were not fully representative of the underlying population since they excluded households without a landline telephone service as well as adults living in institutional group housing (Hygiene 2013). Since the primary aim of this study was to analyze the effects of NYC neighborhoods, data on other race/ethnicities, including those who identify with more than one race/ethnicity, were excluded from the analysis due to small numbers. Additionally, since CHS data for co-morbidities were self-reported, they may have a low sensitivity for assessing health conditions. Self-reported diabetes excludes undiagnosed cases, unreported diabetes, as well as information on glycemic control or cardiovascular health (Thorpe et al. 2009). Lastly, due to small cancer rates for less common specific cancers, age could not be adequately adjusted for.

A fallacy common to ecological studies is the lack of ability to control for confounding and effect modifying effects without misclassification. However, this study allowed an opportunity to understand the relationships of cancer incidence rates in different neighborhood populations with a variety of lifestyle and risk factors of interest obtained over the course of five years. This allowed an examination of a contextual cultural framework for cancer risk and exposure with a five-year latency period.

Multiple aspects of social environments have indeed been demonstrated to be linked to modifiable cancer risk factors, such as obesity (Thorpe et al. 2009), diabetes (Smalls et al. 2014), and smoking ((CDC) 2007). Many modifiable disparities have been observed between NYC neighborhoods (Shareck, Kestens, and Frohlich 2014, Frieden et al. 2008), with EH, CH, and the UES serving as a microcosm for inequalities in cancer screening, co-morbidities, and modifiable lifestyle risks. Primary strategies for reducing cancer risk in the CH and EH neighborhoods include diabetes prevention and awareness, increased academic education, and reducing tobacco smoking. Although further study in NYC has identified disparities in the diabetes care continuum (Thorpe et al. 2009), dietary lifestyle, and tobacco smoking (Frieden et al. 2008), programs that focus on social and demographic neighborhood differences are also necessary to narrow the disparity gap.

Conclusions

Both race/ethnicity and neighborhood residency are important in determining cancer risk. Cancer incidence health burdens may result from preventable causes, in part due to risk factor vulnerability borne from social community ties at the neighborhood level, but also due to race/ethnicity. Due to unique and contrasting neighborhood characteristics, community-based outreach programs aimed at preventive measures may be beneficial in reducing cancer rates. Key domains for cancer risk reduction include interventions in diabetes and tobacco smoking.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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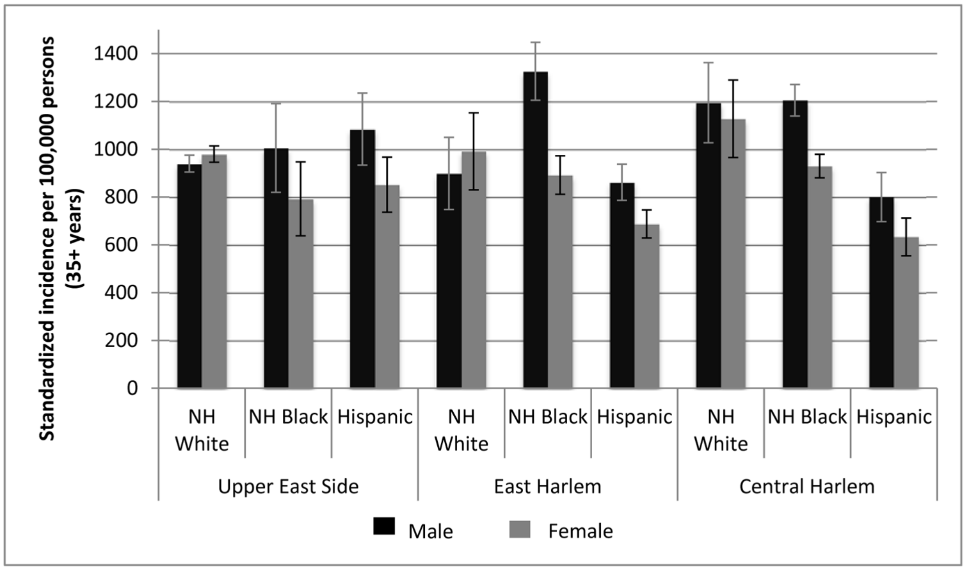

Figure 1.

Age-standardized cancer incidence rates per 100,000 for all sites by United Health Fund New York City neighborhood and race/ethnicity, 2007 to 2011. Vertical bars indicate 95% confidence intervals. NH = non-Hispanic

Table 1

Distributions of cancer counts and age-standardized cancer incidence rates per 100,000 of all cancers combined and the four commonest cancers in New York City United Hospital Fund (UHF) neighborhoods: Upper East Side, East Harlem, and Central Harlem for ≥35 years, 2007–2011 *

Cancer Site	Upper East Side		East Harlem		Central Harlem	
	n (%)	**Incidence rate (Men/Women)**	**n (%)**	**Incidence rate (Men/Women)**	**n (%)**	**Incidence rate (Men/Women)**
All malignant neoplasms	6459 (53)	1010/874	2243 (18)	1029/857	3549 (29)	1066/897
Lung	676 (46)	102/90	301 (21)	160/104	485 (33)	130/102
Colorectal	390 (41)	64/89	208 (22)	97/76	346 (37)	103/87
Female breast	1148 (56)	- /286	345 (17)	- /258	545 (27)	- /280
Prostate	903 (49)	283/ -	330 (18)	293/ -	607 (33)	354/ -

* Source: New York State Cancer Registry

Table 2

Descriptive characteristics of Community Health Survey respondents by United Health Fund (UHF) New York City neighborhoods: East Harlem, Central Harlem, and Upper East Side, 2002–2006

Category	Missing n (% of total surveyed)	Characteristic	Category total	Upper East Side	East Harlem	Central Harlem	*P*-value
Neighborhood	0	Number of participants (%)	2958	1181 (40)	761 (26)	1016 (34)	
Age	154 (5.2)	Age, years (mean, sd)	2804	1109/1181 58.7±15	736/761 54.7±14	959/1016 55.3±15	0.06
	154 (5.2)	Age groups					<0.001
		35–44 years (%)	750(27)	244 (22)	215 (29)	291(30)	
		45–54 years (%)	659(24)	222 (23)	196 (27)	241 (23)	
		55–64 years (%)	543(19)	230 (21)	132 (18)	181(19)	
		65–74 years (%)	426(15)	177 (16)	111 (15)	138 (14)	
		75+ years (%)	426(15)	217 (20)	82 (11)	127 (13)	
Gender	0	Females (%)	1829 (62)	691 (59)	488 (64)	650 (64)	0.01
		Males (%)	1129 (38)	490 (41)	273 (36)	366 (36)	
Race/ethnicity	0	Black, Non, Hispanic (%)	993 (34)	34 (3)	232 (31)	727 (72)	<0.001
	0	Hispanic, all races (%)	682 (23)	71 (6)	453 (60)	158 (16)	
	0	White, Non, Hispanic	1283 (4)	1076 (91)	76 (10)	131 (13)	
Household income	656 (22)	Poverty level ≥30% based on zipcode (%)	839 (36)	32 (4)	408 (64)	399 (50)	<0.001
Education	32 (0.1)	College degree (%)	1340 (46)	870 (74)	145 (19)	325 (32)	<0.001
Self, assessed health	22 (0.7)	General health rated as “fair/poor” (%)	733 (25)	151 (13)	277 (37)	305 (30)	<0.001
	7 (0.2)	US born (%)	2397 (81)	961 (82)	596 (78)	840 (83)	0.05
Sexual identity	190 (8.0)	Homosexual and bisexual (%)	118 (5)	63 (7)	15 (3)	40 (5)	0.02
Neighborhood safety	14 (2.4)	Feel “extremely safe” in neighborhood (%)	95 (17)	68 (33)	12 (7)	15 (8)	<0.001
Body Mass Index	208 (7.0)	Body mass index, (kg/m^2) mean, sd	2750	1105/1181 24.6±4.4	702/761 28.5±7.0	943/1016 27.8±5.7	<0.001
Co-morbities	9 (0.4)	Diabetes mellitus (%)	273 (12)	51 (6)	102 (17)	120 (16)	<0.001
	17 (2.9)	Hypercholester olemia (%)	191 (34)	83 (40)	49 (30)	59 (31)	0.08
	522 (29)	Hypertension (%)	705 (38)	219 (29)	181 (41)	305 (45)	<0.001
	14 (0.6)	Current asthma (%)	136 (6)	35 (4)	50 (8)	51 (7)	<0.001
Health Screening	971 (41)	Ever colonoscopy (%)	893 (64)	448 (71)	182 (55)	263 (59)	<0.001
	250 (17)	Mammogram in past 2 years (%)	1002 (80)	393 (79)	258 (82)	351 (79)	0.43

Category	Missing n (% of total surveyed)	Characteristic	Category total	Upper East Side	East Harlem	Central Harlem	*P*-value
	70 (4.6)	PAP smear in past 3 years (%)	1233 (86)	477 (86)	313 (85)	443 (86)	0.93
	105 (5.8)	HIV test in past 12 months (%)	373 (22)	77 (11)	114 (27)	182 (30)	<0.001
	11 (0.4)	Presence of primary care physician (%)	2471 (84)	1044 (89)	584 (77)	843 (83)	0.001
Access to Health care	43 (1.5)	Uninsured (%)	46 (8)	61 (5)	91 (12)	94 (9)	<0.001
Lifestyle risk factors							
Tobacco smoking	29 (1.0)	Current smokers (%)	613 (21)	172 (15)	191 (25)	250 (25)	<0.001
		Past smokers (%)	892 (30)	467 (40)	165 (19)	260 (29)	<0.001
		Never smokers (%)	1424 (49)	532 (45)	396 (53)	496 (49)	<0.001
	6 (2.6)	Exercise in past 30 days (%)	1676 (73)	739 (85)	405 (64)	532 (67)	<0.001
	50 (2.2)	Binge drinking (%)	245 (11)	92 (11)	75 (3.3)	78 (10)	0.53
	46 (4.0)	Fruit and vegetable servings/day ≥ 5 (%)	117 (11)	75 (18)	18 (6)	24 (6)	<0.001
	582 (20)	≥ 3 sex partners (%)	148 (6)	70 (8)	31 (5)	47 (6)	0.18

Table 3

Associations of neighborhood and race with overall cancer incidence and incidence for the most common four sites, 2007–2011

Cancer	Model	Race		UHF neighborhood		Community Health Survey (CHS) variables and association direction	Likelihood ratio test
		Black vs. White	Hispanic vs. White	East Harlem vs. Upper East Side	Central Harlem vs. Upper East Side		P-value
All Cancers	Model 1[a]	**1.08 (1.02, 1.16)**	**0.83 (0.78, 0.89)**	0.99 (0.93, 1.07)	0.99 (0.93, 1.07)		
	Model 2[b]	**0.84 (0.74, 0.95)**	**0.64 (0.56, 0.74)**	**1.34 (1.07, 1.68)**	**1.39 (1.12, 1.72)**	Poverty level − Number of sex partners + Diabetes + Current smoking + College graduate −	<0.001
Female breast	Model 1	**0.74 (0.63, 0.88)**	0.88 (0.75, 1.04)	0.88 (0.74, 1.04)	0.92 (0.78, 1.08)		
	Model 2	1.13 (0.91, 1.42)	1.03 (0.75, 1.35)	0.84 (0.70, 1.02)	0.95 (0.79, 1.14)	Fruit and vegetable consumption − Health insurance possession − Heavy smoker (>10 cigarettes +/day) Mammogram in past 2 years + Physical exercise in past 30 days +	<0.001
Prostate	Model 1	**1.44 (1.22, 1.69)**	0.83 (0.70, 1.00)	1.05 (0.88, 1.25)	1.13 (0.96, 1.33)		
	Model 2	**1.41 (1.14, 1.75)**	0.76 (0.61, 1.01)	0.85 (0.65, 1.11)	0.95 (0.74, 1.21)	Felt “extremely safe” in neighborhood − Heterosexual orientation +	<0.001
Lung	Model 1	**1.33 (1.10, 1.60)**	**0.78 (0.64, 0.96)**	**1.25 (1.02, 1.51)**	**1.21 (1.00, 1.47)**		
	Model 2	**1.50 (1.21, 1.87)**	**0.82 (0.67, 1.01)**	**1.27 (1.04, 1.55)**	1.17 (0.96, 1.42)	Sex and age interaction Body Mass Index (BMI) − Current smoking +	<0.0001
Colorectal	Model 1	**1.43 (1.13, 1.80)**	1.12 (0.88, 1.43)	1.22 (0.96, 1.56)	**1.34 (1.06, 1.70)**		
	Model 2	1.09 (0.80, 1.47)	0.71 (0.49, 1.03)	1.21 (0.95, 1.54)	**1.38 (1.09, 1.76)**	Sex and age interaction Asthma + BMI + Has primary care physician −	0.002

[a] Model 1 includes terms for age category, gender, race/ethnicity, and United Health Fund neighborhood.

[b] Model 2 includes terms for the four categories in Model 1 in addition to statistically significant Community Health Survey (CHS) variables.