Cactus. X-Ray image courtesy of Bryan Whitney. www.x-rayphotography.com.

We must continue to focus attention and effort to reduce the disproportionate burden of cancer among blacks living in the United States.

Black Heterogeneity in Cancer Mortality: US-Blacks, Haitians, and Jamaicans

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Introduction: *The quantitative intraracial burden of cancer incidence, survival and mortality within black populations in the United States is virtually unknown.*

Methods: *We computed cancer mortality rates of US- and Caribbean-born residents of Florida, specifically focusing on black populations (United States, Haiti, Jamaica) and compared them using age-adjusted mortality ratios obtained from Poisson regression models. We compared the mortality of Haitians and Jamaicans residing in Florida to populations in their countries of origin using Globocan.*

Results: *We analyzed 185,113 cancer deaths from 2008 to 2012, of which 20,312 occurred in black populations. The overall risk of death from cancer was 2.1 (95% CI: 1.97–2.17) and 1.6 (95% CI: 1.55–1.71) times higher for US-born blacks than black Caribbean men and women, respectively (*P < .001*).*

Conclusions: *Race alone is not a determinant of cancer mortality. Among all analyzed races and ethnicities, including Whites and Hispanics, US-born blacks had the highest mortality rates while black Caribbeans had the lowest. The biggest intraracial difference was observed for lung cancer, for which US-blacks had nearly 4 times greater mortality risk than black Caribbeans. Migration from the islands of Haiti and Jamaica to Florida resulted in lower cancer mortality for most cancers including cervical, stomach, and prostate, but increased or stable mortality for 2 obesity-related cancers, colorectal and endometrial cancers. Mortality results in Florida suggest that US-born blacks have the highest incidence rate of "aggressive" prostate cancer in the world, rather than Caribbean men.*

Introduction

Cancer is the second leading cause of death among blacks in the United States. In relative terms, black men and women suffer the largest cancer burden, with higher mortality and lower survival compared to all major racial-ethnic groups: whites, Asians, Hispan-

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Submitted November 23, 2015; accepted March 4, 2016.

This document is the unedited authors' version of a submitted work that was accepted for publication.

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No significant relationships exist between the authors and the companies/organizations whose products or services may be referenced in this article.

Data provided by the Florida Department of Health, Bureau of Vital Statistics. Any conclusions are the authors' own and do not necessarily reflect the opinion of the Florida Department of Health.

Dr Pinheiro is sponsored by 8 P20 GM103440-11 from the National Institute of General Medical Sciences as a NV/INBRE recipient.

ics, and American Indians.[1,2] Black males also have the greatest cancer incidence.[2] These cancer disparities by race are the result of a complex and entangled web of differences in risk factors that directly impact not only cancer incidence, but also access to and availability of early detection and timely treatment. In turn, these affect the capacity to successfully combat cancer, thus impacting cancer survival. Cancer mortality is a result of the interplay between both incidence and survival. Assessing each of these 3 components — incidence, survival, and mortality — is critical to understanding how disparities between populations arise and how they can be reduced or eliminated.

Black men and women in the United States are often categorized under a single ostensibly homogenous umbrella: blacks, United States blacks, African Americans, or people of African descent. For researchers, the use of different denominations for describing populations can lead to confusion. "United States blacks", commonly used for data collection, may or may not characterize blacks born outside of the United States, and "African descent" may include North African populations. For well-documented historical reasons, the vast majority of black people living in the Western hemisphere are genetic admixtures of African, European, and/or Native American populations, warranting caution when attributing risk to race, a social construct.[3] Most importantly, however, the use of one aggregate term obscures considerable heterogeneity in health outcomes among the black population in the United States, irrespective of whether these differences are attributable to biological, cultural, or socioeconomic factors.[4]

Blacks born outside the United States number 3.8 million in the United States, nearly 9% of the black population.[5] According to Census projections, this percentage will reach 17% by 2060.[6] Substantial black immigration into the United States is a recent dynamic following the Immigration America Act of 1963.[7] The majority of black immigrants come from English and French speaking nations of the Caribbean, led by Jamaica and Haiti, the birthplace of 18% and 15% of United States-black immigrants in 2013.[6] To the extent that health is partially determined by social and cultural factors, including beliefs on disease etiology, types of family structure and social support, expectations regarding medical care, as well as cumulative lifetime exposure to cancer risk factors, aggregating these distinct Caribbean populations together with blacks who have been in the United States for generations may limit the ability to detect and address culturally driven determinants of health outcomes among all black heterogeneous sub-populations.[4,8,9]

Two studies have shown lower overall cancer mortality for blacks born outside of the United States than for US-born.[10,11] Yet a more detailed analysis of the intraracial cancer heterogeneity in black populations living in the United States is non-existent. Problems studying this topic derive from limitations in the available incidence and survival data. First, cancer registries do not collect demographic data on black ancestries. Secondly, the collection of birthplace is substantially incomplete in the United States cancer surveillance programs.[12,13] These limitations have impeded unbiased cancer incidence and survival studies of these populations.[14-16] Birthplace reporting on death certificates, however, is nearly complete. Thus, mortality data can be a valuable source of information for assessing the intraracial cancer heterogeneity among blacks in the United States.

Here we use cancer mortality data for Florida, a state with a 19% immigrant and 17% black population,[17] to analyze cancer outcome heterogeneity. First, we compare US-born populations of all races with Hispanic Caribbean populations and majority-black Caribbean populations born outside the United States. Then, we compare US-born blacks with majority-black Caribbean populations. Within the latter, we look specifically at Haitians, Jamaicans, and other West Indian populations. Through this analysis we aim to characterize race-specific patterns of cancer mortality, explore the intraracial heterogeneity in blacks, and make a contribution that will assist health policy makers in shaping targeted cancer prevention and control efforts to reduce health inequities in cancer outcomes in the United States.

Materials and Methods

Cancer Data

Cancer mortality data for 5 years, January 1, 2008 through December 31, 2012, were obtained from the Florida Department of Health Vital Statistics.[18] We considered only resident cases in the state. We analyzed the most common causes of cancer death: lung and bronchus, breast, prostate, colorectal, pancreas, corpus uteri (endometrial); and cancers of special interest in populations born outside the United States: cervix uteri, liver, stomach; and all-sites-combined, which included all cases of malignant cancers. Cancer site was coded according to the International Statistical Classification of Diseases 10th revision.

We examined the cancer mortality burden at 2 levels of comparison. First, all Florida populations regardless of race and based on birthplace alone: US-born populations and the following 2 immigrant Caribbean populations: Hispanic Caribbean, including Cuba, the Dominican Republic and Puerto Rico, and majority-black Caribbean including Haiti, Jamaica and Other West Indies (OWI). Haiti and Jamaica are considered separately as they are the 2 largest non-Hispanic Caribbean immigrant groups in Florida as well as the United States.[7] The OWI category included the following territories and island nations: Anguilla, Antigua

and Barbuda, Aruba, Bahamas, Barbados, Cayman Islands, Dominica, Grenada, Guadeloupe, Martinique, Montserrat, Saint Kitts and Nevis, Saint Barthelemy, Saint Lucia, Saint Martin, Saint Vincent and the Grenadines, the Netherlands Antilles, the British Virgin Islands, Trinidad and Tobago, Turks and Caicos, and West Indies not otherwise specified. The vast majority of immigrants from these nations are black, including 99% of all Haitians immigrants and 96% of all Jamaicans.[7] Thus, while recognizing that a small number of immigrants born in these countries may not be black, we will for the purposes of this paper refer to these populations as black Caribbean. To strictly adhere to the Caribbean definition as a geographical region distinct from the continental Americas, Belize and Guyana, (although also majority black populations), were excluded from the OWI category.

Second, we examined a subset of the Florida population, based on race for US-born populations and birthplace for those born in the Caribbean. We compare US-born blacks with the black population born outside the United States. Caribbean populations combined (Haiti, Jamaica, and OWI), as well as the 2 largest populations, Haitians and Jamaicans. For simplicity purposes in the current study, the Haitian-born, Jamaican-born, and those born in other West Indies (OWI), and Hispanic Caribbean-born populations are referred to as Haitian, Jamaican, OWI and Hispanic Caribbean. The designation US-blacks will exclusively refer to US-born blacks.

Non-Hispanic black populations from Africa or elsewhere outside the United States or the Caribbean were excluded from this study. These excluded populations are relatively young with a more recent immigration history,[6,7] and accounted only for 1% — approximately 40 deaths annually — of all cancer deaths in Florida among blacks in 2008–2012.

Population Data

The American Community Survey estimates for 2010 indicated that 30% (795,500) of the total 2.6 million people of non-Hispanic West Indian ancestry in the United States, lived in Florida.[19] Of the 2.4 million blacks in Florida, 33% were of Caribbean ancestry, representing the highest proportion of a Caribbean black-majority population in any American state.[19] Since specific ancestry information is unavailable for cancer mortality data, we are using birthplace. While ancestry and birthplace are not exactly overlapping, the overwhelming majority of the Caribbean population in the United States aged 30 and above was born outside the United States.[6,7] These older age groups are also the ones where cancer will be an important cause of death; therefore, birthplace and ancestry are not likely to result in substantially different mortality numbers. Looking at birthplace alone in Florida in 2010, there were 14.6 million US-born (10.2 million whites, 2.4 million blacks, 2 million other races); 1.3 million Hispanic Caribbean-born; and 570,000 black Caribbean-born (277,000 Haitians, 196,000 Jamaicans and 97,000 OWIs).[19]

Population denominators for the State of Florida were obtained from the 5-year 2008–2012 American Community Survey using the University of Minnesota interface,[20] thus serving the same years as our mortality data. Population numbers were grouped by birthplace and by gender for all groups, and also by race for the US-born.

Data Analysis

A very small number of cases of non-Hispanic blacks with unknown birthplace (n = 145, 0.7% of the total) were proportionally reassigned by imputation models stratified by age, sex, and cancer site into the United States, Haiti, Jamaica, OWI, and all other non-US birthplaces as described elsewhere.[21]

Cancer mortality rates for 2008–2012 were calculated per 100,000 persons, annualized and age-standardized to the 2000 US Standard Population and the 2000 World Standard Population using eighteen age group bands, all 5-year except the last, which was 85 and older. We used mortality and population data for a period of 5 years (2008–2012), accumulating cancer mortality data for a total of 2.85 million person-years for black Caribbean populations. Corresponding 95% confidence intervals (CIs) were calculated with gamma intervals modification.[22] Site-specific mortality ratios with 95% CIs were computed by using Poisson regression adjusted for 5-year age groups starting at age 35, except for prostate cancer where the groups started at age 50. Because breast cancer risk factors differ between pre- and post-menopausal women and these rates differ by race,[23] we used approximate pre- and post-menopausal ages, using 50 as our dividing age, to calculate pre- and post- menopausal ratios. SAS 9.3 (SAS Institute Inc., Cary, NC, USA) was used for data analysis.

The OWI cancer burden in Florida was distributed between more than 20 different countries and territories of origin, the largest of which were Trinidad and Tobago at 34%, Bahamas at 22% and Barbados at 9%. This diverse origin as well as relatively small numbers makes interpretation of the results difficult. Moreover, unlike Haiti and Jamaica, some of these countries have a more diverse racial composition, including Trinidad and Tobago, with a 38% East Indian population.[7] Nonetheless, we present OWI data to demonstrate Caribbean completeness.

Finally, we calculated age-adjusted mortality rates, adjusted to the 2000 World Standard, for Haitian and Jamaican immigrant populations and well as US-born blacks living in Florida.

For comparison purposes, we used the best avail-

able data from each of these countries, the 2009-2011 average cancer mortality rates from the World Health Organization Mortality Database[24] for Jamaica, and the 2012 Globocan[25] estimates for Haiti.

This study was approved by the University of Nevada, Las Vegas Institutional Review Board. A data use agreement was obtained from the Florida Vital Statistics Department.

Results

A total of 841,054 deaths were recorded among Florida residents during 2008–2012; 185,113 were deaths attributed to cancers in US-born and Caribbean-born populations (Table 1). There were 16,119 cancer deaths in US-blacks, and 4,113 among black Caribbeans. People born in Jamaica accounted for 43% of these deaths, those from Haiti, 38%, and from OWI countries, 19%.

For 2008–2012 in Florida, cancer was the leading cause of death for US-born women as well as for the black Caribbean populations. It accounted for 27.2% of all deaths among Jamaicans and 23.7% among Haitians. Cancer ranked second only to heart disease as the leading cause of death among the US-born male population as well as males and females born in Hispanic Caribbean countries.

In comparison to the total US-born Florida population, both black Caribbeans and Hispanic Caribbeans have lower all-sites-combined cancer mortality rates. However, there is considerable heterogeneity in the rates between them and by cancer site (Tables 1-2). For black Caribbeans, there were significantly higher mortality rates for stomach, prostate and endometrial cancers than the US-born; among Hispanic Caribbeans, mortality rates were higher for stomach and liver cancers. Both Hispanic and black Caribbean populations had lower rates for lung, pancreas and breast cancers when compared to the US-born population.

Table 1. — Average Annual Age-Adjusted* Mortality Rates for Selected Cancers (per 100,000) by Birthplace: Florida, 2008–2012

	US-Born		Born Outside the United States			
	United States All Races		Hispanic Caribbean** All Races		Majority Black Caribbean All Races	
	Deaths	Rate (95% CI)	Deaths	Rate (95% CI)	Deaths	Rate (95% CI)
Male						
Stomach	1,386	3.2 (3.0–3.4)	235	4.7 (4.2–5.5)	97	6.7 (5.4–8.4)
Colorectal	7,455	16.9 (16.6–17.3)	917	18.2 (17.1–19.5)	206	13.8 (11.9–16.1)
Liver and Intrahepatic Bile Duct	3,766	8.4 (8.1–8.7)	476	9.3 (8.5–10.3)	109	6.9 (5.6–8.5)
Pancreas	5,392	12.1 (11.7–12.4)	540	10.6 (9.7–11.6)	128	9.1 (7.5–11.1)
Lung and Bronchus	28,023	62.3 (61.6–63.1)	2,287	44.7 (42.8–46.6)	317	21.0 (18.6–23.6)
Prostate	7,936	17.9 (17.5–18.3)	943	19.1 (17.9–20.4)	437	35.5 (32.1–39.3)
All combined	89,387	201.7 (200.4–203.1)	8,487	169.4 (165.7–173.2)	2,020	141.4 (134.9–148.2)
Female						
Stomach	911	1.7 (1.6–1.8)	173	2.6 (2.2–3.2)	92	4.6 (3.7–5.8)
Colorectal	6,335	11.7 (11.4–12.0)	855	12.4 (11.6–13.4)	243	11.9 (10.4–13.6)
Liver and Intrahepatic Bile Duct	1,518	2.8 (2.7–3.0)	260	3.8 (3.3–4.4)	76	3.9 (3.0–5.0)
Pancreas	4,874	8.9 (8.7–9.2)	537	7.6 (7.0–8.4)	129	6.4 (5.4–7.8)
Lung and Bronchus	22,217	41.9 (41.4–42.5)	1090	16.1 (15.2–17.2)	194	9.8 (8.4–11.4)
Breast	10,819	21.6 (21.2–22.1)	1,100	17.5 (16.4–18.6)	413	19.1 (17.3–21.2)
Pre-menopausal, less than 50	1,141	3.9 (3.7–4.1)	100	2.6 (2.1–3.2)	97	4.8 (3.9–6.0)
Post-menopausal, 50 or more	9,678	17.8 (17.5–18.2)	1,000	14.9 (14.0–15.9)	316	14.3 (12.7–16.1)
Cervix Uteri	1,140	2.8 (2.6–3.0)	138	2.6 (2.2–3.2)	68	3.3 (2.5–4.3)
Corpus and Uterus (endometrial)	1,975	3.8 (3.6–4.0)	278	4.2 (3.7–4.8)	152	7.3 (6.2–8.7)
All combined	74,241	141.4 (140.4–142.5)	6,890	104.6 (102.1–107.3)	2,093	103.6 (98.7–108.8)

*2000 US Standard Population **Cuba, Dominican Republic and Puerto Rico

Table 2. — Average Annual Age-Adjusted* Mortality Rates for Selected Cancers per 100,000 for US-Born and Blacks Born Outside the United States: Florida, 2008–2012

	US-Born		Born Outside the United States							
	Blacks		Black Caribbean** All Races		Haitian All Races		Jamaican All Races		Other West Indian (OWI) All Races	
	Deaths	Rate (95% CI)	Deaths	Rate (95% CI)	Deaths	Rate (95% CI)	Deaths	Rate (95% CI)	Deaths	Rate (95% CI)
Male										
Stomach	292	9.4 (8.3–10.6)	97	6.7 (5.4–8.4)	45	7.4 (5.2–10.3)	39	6.8 (4.8–11.9)	<15	5.0 (2.4–14.5)
Colorectal	895	28.3 (26.3–30.4)	206	13.8 (11.9–16.1)	83	12.4 (9.7–15.8)	86	14.7 (11.6–20.3)	37	15.4 (10.4–25.7)
Liver and Intrahepatic Bile Duct	436	11.0 (9.9–12.2)	109	6.9 (5.6–8.5)	69	9.4 (7.2–12.2)	28	4.6 (3.0–9.6)	<15	4.5 (2.0–14.0)
Pancreas	474	14.7 (13.3–16.2)	128	9.1 (7.5–11.1)	34	5.0 (3.4–7.4)	63	11.5 (8.8–17.0)	31	11.6 (7.5–21.4)
Lung and Bronchus	2,536	78.9 (75.6–82.3)	317	21.0 (18.6–23.6)	105	17.5 (14.1–21.6)	153	25.1 (21.1–31.2)	59	21.2 (15.6–31.7)
Prostate	1,218	50.6 (47.6–53.7)	437	35.5 (32.1–39.3)	142	29.2 (24.3–34.7)	194	37.8 (32.4–45.2)	101	44.0 (35.0–57.3)
All combined	8,575	273.9 (267.6–280.3)	2,020	141.4 (134.9–148.2)	753	124.5 (115.1–134.6)	883	154.4 (143.9–166.4)	384	148.3 (132.2–167.6)
Female										
Stomach	179	4.0 (3.4–4.6)	92	4.6 (3.7–5.8)	42	4.9 (3.5–6.9)	31	3.7 (2.5–6.8)	19	6.4 (3.8–11.8)
Colorectal	809	17.7 (16.5–19.0)	243	11.9 (10.4–13.6)	75	8.6 (6.7–11.1)	122	14.2 (11.8–18.1)	46	13.4 (9.7–19.5)
Liver and Intrahepatic Bile Duct	169	3.6 (3.0–4.1)	76	3.9 (3.0–5.0)	37	4.6 (3.2–6.6)	28	3.3 (2.2–6.5)	<15	3.4 (1.6–8.2)
Pancreas	532	11.8 (10.8–12.8)	129	6.4 (5.4–7.8)	53	6.7 (5.0–9.0)	47	5.3 (3.9–8.6)	29	9.3 (6.1–15.0)
Lung and Bronchus	1,473	32/3 (30.6–34.0)	194	9.8 (8.4–11.4)	66	8.6 (6.6–11.2)	95	11.1 (8.9–14.7)	33	10.3 (7.0–16.1)
Breast	1,514	32.1 (30.4–33.7)	413	19.1 (17.3–21.2)	158	17.0 (14.4–20.2)	187	21.1 (18.2–25.4)	68	19.0 (14.6–25.6)
Pre-menopausal, less than 50	298	6.2 (5.5–6.9)	97	4.8 (3.9–6.0)	50	5.2 (3.9–7.1)	38	5.2 (3.7–8.6)	<15	2.6 (1.2–7.3)
Post-menopausal, 50 or more	1,216	25.9 (24.4–27.4)	316	14.3 (12.7–16.1)	108	11.8 (9.6–14.6)	149	15.9 (13.5–19.2)	<68	16.4 (12.4–22.7)
Cervix Uteri	267	5.5 (4.8–6.2)	68	3.3 (2.5–4.3)	36	3.9 (2.7–5.7)	20	2.6 (1.6–5.8)	<15	3.6 (1.8–8.5)
Corpus and Uterus (endometrial)	373	8.1 (7.3–9.0)	152	7.3 (6.2–8.7)	49	5.7 (4.2–7.8)	75	8.6 (6.7–12.1)	28	7.6 (5.0–12.8)
All combined	7,544	163.2 (159.5–167.0)	2,093	103.6 (98.7–108.8)	798	95.6 (88.5–103.3)	902	105.4 (98.4–113.4)	393	121.3 (106.8–137.8)

*2000 US Standard Population **Haiti, Jamaica and OWI combined

When narrowing the comparisons to Haitian, Jamaican, and US-black populations in Florida, the cancer mortality rate differences are surprisingly even greater (Table 2). Haitians have the lowest mortality rates for all cancers combined, 125 per 100,000 among males and 96 per 100,000 in females, followed closely by Jamaicans with 154 and 105 per 100,000 among males and females, respectively. Contrasting with these relatively low rates, US-blacks had high mortality rates, 274 per 100,000 for males and 163 per 100,000 for females. The risk of cancer death in US-black males is 2.1 times higher than among black Caribbean males and 1.6 times higher for black Caribbean females ($P < .05$). Of all cancers examined, lung cancer has the greatest risk differential. US-blacks compared to black Caribbeans have an astonishing 4 times greater risk of lung cancer death among males and a 3.5 times greater risk among females (Table 3).

The leading cause of cancer mortality among US-black males was lung cancer, at 78.9 per 100,000, followed distantly by prostate cancer at 50.6 per 100.000. For black Caribbean males the opposite was true: prostate cancer mortality was highest, at 35.5 per 100,000, followed by lung cancer at 21.0 per 100,000 (Table 2). Across the male populations of US-blacks, Jamaicans, Haitians, and OWIs, colorectal was the third leading cause of cancer death, while pancreatic cancer was fourth, except among Haitians for whom liver cancer was fourth.

Among US-black women in Florida, the 2 most common causes of cancer mortality were lung and breast, almost equal at 32.3 and 32.1 per 100,000 respectively, followed by colorectal and pancreatic cancers. For black Caribbean women, breast cancer was by far the leading cause of cancer mortality at 19.1 per 100,000, with colorectal cancer second and lung cancer only third (Table 2). Still, US-black women had a 1.7 times greater overall mortality risk for breast cancer than black Caribbean women, although pre-menopausal breast cancer risk was only 1.3 times higher (Table 3). Endometrial cancer was the fourth leading cause of cancer death for black Caribbean women. Notably, cervical cancer rates were relatively low across black Caribbean female populations.

Lastly, the cancer mortality rates of Haitian and Jamaican populations residing in Florida when compared to the rates in their respective countries of origin are lower for both males and females for all cancer sites combined (Table 4). This advantage is most marked for cervix, stomach, and prostate cancers for both countries, liver cancer for Haitians and female breast for Jamaicans. On the other hand, for colorectal (male and female), endometrial, and pancreatic cancers, mortality rates are higher for Haitians and relatively similar for Jamaicans in Florida in comparison to rates found in the countries of origin. Also higher in Florida than in countries of origin are rates for lung cancer among Haitian males and Jamaican females as well as breast cancer among Haitian females (Table 4).

Table 3. — Mortality Rate Ratios for Selected Cancers: Florida, 2008–2012

	US-Born Blacks in Relation to Black Caribbean (Reference Population)	
	Rate Ratio	95% CI
Male		
Stomach	1.4	(1.13–1.80)
Colorectal	2.1	(1.81–2.46)
Liver and Intrahepatic Bile Duct	1.9	(1.55–2.39)
Pancreas	1.8	(1.45–2.15)
Lung and Bronchus	4.0	(3.51–4.45)
Prostate	1.4	(1.29–1.61)
All combined	2.1	(1.97–2.17)
Female		
Stomach	0.9	(0.66–1.09)
Colorectal	1.5	(1.30–1.73)
Liver and Intrahepatic Bile Duct	1.0	(0.77–1.34)
Pancreas	1.9	(1.55–2.27)
Lung and Bronchus	3.5	(2.99–4.03)
Breast	1.7	(1.48–1.84)
Pre-menopausal, less than 50	1.3	(0.99–1.60)
Post-menopausal, 50 or more	1.8	(1.55–1.99)
Cervix Uteri	1.7	(1.30–2.24)
Corpus and Uterus (endometrial)	1.1	(0.93–1.35)
All combined	1.6	(1.55–1.71)

*Poisson regression rate ratios adjusted for age group

Discussion

This is the first study to address intraracial differences in cancer mortality among persons often categorized under the US-blacks designation. Using birthplace, we differentiate and directly compare black populations born in and outside the United States, presenting the first quantification of the cancer burden for black Caribbeans. In Florida, cancer mortality rates for US-blacks are higher than all analyzed groups. However, black Caribbean populations have the lowest rates, suggesting that racial health disparities in the United States are attributable to more than socioeconomic status (SES) and health care access, for which Caribbeans are likely to be at least equally as disadvantaged as US-blacks.

The major contributor for the relatively low overall cancer mortality in blacks born outside the United States is the difference in lung cancer rates. This is most likely a reflection of differences in smoking hab-

Table 4. — Mortality Rates* (per 100,000) for Selected Cancers for Haitians and Jamaicans in Country of Origin and in Florida and for US-Blacks: Florida, 2008–2012

	Haitians		US-Blacks	Jamaicans		US-Blacks
	In country of origin, Haiti	In Florida	In Florida	In Country of Origin, Jamaica	In Florida	In Florida
Male						
Stomach	8.7	5.1	6.3	9.6	4.9	6.3
Colorectal	4.6	9.2	19.3	9.8	10.7	19.3
Liver and Intrahepatic Bile Duct	7.5	7.4	8.8	3.1	4.0	8.8
Pancreas	2.6	3.6	10.3	3.1	7.2	10.3
Lung and Bronchus	6.6	11.9	55.1	24.1	18.7	55.1
Prostate	32.3	17.3	28.8	40.1	22.2	28.8
All-site combined	88.4	85.6	186.3	131.8	107.4	186.3
Female						
Stomach	6.0	3.6	2.6	4.1	2.7	2.6
Colorectal	5.8	6.4	12.3	9.7	9.5	12.3
Liver and Intrahepatic Bile Duct	5.1	3.2	2.6	2.4	2.2	2.6
Pancreas	2.3	4.6	8.2	3.1	3.5	8.2
Lung and Bronchus	6.2	5.6	23.1	6.0	7.5	23.1
Breast	11.5	13.4	24.0	21.5	16.0	24.0
Cervix uteri	14.6	3.1	4.4	12.8	2.0	4.4
Corpus and Uterus (endometrial)	1.4	4.2	6.0	6.6	5.9	6.0
All-site combined	80.3	69.2	117.7	99.7	75.0	117.7

*Average annual age-adjusted to 2000 World Standard.
Country of origin data: Haiti, GLOBOCAN 2012; Jamaica, WHO Mortality Database 200–2011 average.

its 2 to 4 decades ago. In 1980, the prevalence of smoking in Haiti (18% males, 6% females) and Jamaica (27% males, 7% females) was much lower than in US-blacks (45% males, 31% female).[26] Moreover, studies have documented that blacks born outside the United States are less likely to smoke than their US-born counterparts.[27,28] The risk factor of smoking may also account for some of the differences seen in stomach and pancreatic cancers, as well as other tobacco-related cancer sites like bladder, larynx, and oral cavity which are included in the all sites combined category.[29]

Our lower cancer mortality findings among Caribbean blacks may be partially explained by the Healthy Immigrant Effect (HIE), whereby immigrants have better overall health outcomes not solely related to observable socioeconomic factors such as education and income.[10,30,31] In other words, those who immigrate may represent a healthier sample of the population than those who remain in the country of origin.[32] Having said that, immigrants also likely carry with them baseline protective factors inherent to their countries of origin that are persistent in reducing risk, and resistant to the negative effects of acculturation, as has been shown for Hispanics, particularly for Mexican Hispanics.[21] Caribbean immigrants in the United States tend to maintain traditional dietary patterns that include less red meat consumption and higher intake of whole grains, fruits and vegetables, which are protective against colorectal and cancers of the upper gastrointestinal tract.[33-36] Also, fertility rates and breastfeeding patterns may help explain breast cancer differences.[23] Several studies demonstrated significantly higher odds of breastfeeding initiation among immigrant black women than US-born blacks.[37-39] Overall, the lower rates we found for breast and colorectal cancers among black Caribbeans are all the more surprising in light of previous studies documenting lower rates of mammography and colonoscopy among blacks born outside the United States, especially Haitians, in comparison to US-born blacks.[40-43] Additionally, if they are of low SES, non–US-citizen immigrants are less likely than citizens to have had consistent health insurance.[44] In the case of the undocumented or recently documented, access is blocked to any federal assistance programs in Florida except limited emergency Medicaid.[45]

While most intraracial cancer mortality differences in our study seem to be determined by environmental factors, some of which are inherently related to place of birth, it is important to note that some patterns are seemingly more related to race and possibly genetics, regardless of geography. Endometrial, premenopausal breast (defined here as below age 50) and prostate cancer rates reveal specific vulnerabilities. Compared to other groups, all black populations (US-blacks, Haitians, and Jamaicans) have higher mortality for

these 3 cancers. Endometrial cancer is a cancer of the Western world,[46] highly related to obesity,[36] whose prevalence commonly increases among first generation immigrants to the United States.[21] Studies have shown that endometrial cancer survival and mortality outcomes for black women, even after adjustment for their higher proportion of hysterectomies, are worse than all other racial groups.[47,48] Black women also have an elevated risk of more aggressive tumor subtypes with poorer prognosis.[48,49]

For premenopausal breast cancer, the finding of high mortality among all analyzed black populations relative to the all US races category as well as Hispanic Caribbeans is intriguing and requires further study. Given the lack of detailed incidence data for each of these populations, it is impossible to assess whether this finding can be attributed to the well-documented survival disparity between blacks and Whites in the United States,[50] or if it reflects a true increased risk for premenopausal breast cancer among black women.

For prostate cancer, black African descent has been well established as a risk factor.[1,51,52] Our results confirm high rates among both US-born and Caribbean-born blacks. However, the significantly higher rates we find for US-blacks compared to Caribbean-born blacks is notable, given the lower prostate cancer screening rates for the latter compared to the former.[40,53,54] While prostate cancer incidence rates are challenging to compare globally due to increased use of prostate-specific antigen (PSA) screening in some countries,[55,56] mortality rates in Florida likely reflect the incidence of aggressive prostate cancer. Thus, our study is highly indicative of US-blacks having the highest aggressive prostate cancer incidence in the world, not Caribbeans as previously suggested.[57]

Three infection-related cancers — cervical, liver and stomach cancer — are more commonly found in developing countries.[46] Strangely, the mortality rates are similar or even higher for US-blacks compared to the black populations born outside the United States. For cervical cancer, despite the fact that the pap test screening rates are higher among US-black women than Caribbean-born black women[23,53,58] which would predict earlier stages at diagnosis with better prognosis, the mortality rates for cervical cancer are higher in US-blacks than Caribbean-born black women. For liver cancer, it is possible that the epidemiology and patterns of transmission are different between these populations, resulting in different gender-specific incidence and thus mortality. Hepatitis C, a more common liver cancer risk factor than hepatitis B in the United States, is largely transmitted by sharing contaminated intravenous drug needles.[59] The greater differential in liver cancer between males and females in US-blacks than in Caribbean blacks may be the result of greater IV drug use among US-black men than US-black women.[60] For Caribbeans, Hepatitis B likely accounts for the high rates, especially among Haitians,[61] and would not result in a marked gender difference. As a result, liver cancer mortality rates are higher for US black males but similar between US-black females and black Caribbean females in our study.

Haitians and Jamaicans were clearly distinct in their cancer mortality patterns, although the precision of the statistical comparisons may be impacted by the relatively small size of the populations in Florida. Haitians had lower all-sites-combined mortality rates than Jamaicans as well as all other analyzed populations. However, for all 3 infection-related cancers, liver, cervical and stomach, Haitian mortality rates exceeded those of Jamaicans. Haitian rates were lower than Jamaicans' for prostate, breast, endometrial and colorectal cancers: all cancers commonly associated with a "Western" lifestyle.[62] Jamaicans have a longer immigration history in Florida than Haitians;[20] therefore it is possible that these differences reflect acculturation patterns, predicted by length of time in the United States, and the extent of assimilation into US culture, which may be greater for English-speaking Jamaicans. Additionally, since the country of Jamaica has been more developed than Haiti for at least the past 25 years,[63] the prevalence of baseline immigrant risk factors such as obesity may already be more "Westernized".[64]

Additional important findings arise from the examination of differences in mortality rates between Haitians and Jamaicans in their countries of origin compared to those same populations in Florida. Since mortality is a function of cancer incidence and survival, changes in mortality rates may reflect a difference in either or both of these. If the healthcare infrastructure in Florida is better than in Jamaica and Haiti, we would expect cancer survival to be higher, and thus mortality rates to be lower among Jamaicans and Haitians in Florida than in their countries of origin. Despite the fact that survival data accuracy for blacks born outside the United States can be problematic,[16] some studies have documented this pattern.[65-68] On the other hand, if Caribbeans living in Florida have higher or even stable cancer mortality rates compared to their counterparts in their countries of origin, then these changes likely reflect true increases in incidence rather than decreases in survival.

In our study, mortality rates for Haitians and Jamaicans in Florida compared to their countries of origin were predictably lower for all 3 infection-related cancers, except for liver cancer in male Jamaicans. Stomach cancer gains are likely attributable to a higher standard of living in the United States coinciding with a lower prevalence of infection with *Helicobacter pylori*.[69,70] Likewise, lower liver cancer mortality rates in Florida populations compared to their countries of origin suggest lower incidence, at least in part due to

a lower prevalence among US blacks (0.9%) of chronic hepatitis B compared to prevalence in Jamaica (3.7%) or Haiti (13.6%).[61,71] Gains for cervical cancer were substantial in both Haitian and Jamaican populations in Florida, with mortality rates reduced to less than 25% of the rates in their countries of origin. This likely reflects improved access to health care, including screening and radiotherapy treatment, which would impact incidence and survival, respectively. The same likely applies to the substantial improvement for female breast cancer among Jamaicans.

We also found an advantage for prostate cancer for immigrants living in Florida. Mortality rates among Haitians and Jamaicans are substantially lower in Florida than in the country of origin. This is not remarkable given the complexity of prostate cancer control: including screening, computed tomography and bone scans for staging, surgery, hormone therapy and radiotherapy.

The mortality rates for colorectal cancer in both sexes and endometrial cancer in women suggest an increased risk in Florida compared to the country of origin. For Haitians, the rates are significantly higher than in their countries of origin, while for Jamaicans there is minimal change. Yet, in the United States, access to colorectal screening if utilized would result in either averted cancer by removal of precancerous lesions or earlier cancer diagnosis.[72] Moreover, since there is no knowledge of latent forms of either colorectal or endometrial cancers, which eventually progress to death if left untreated, access to better health care facilities should result in improved treatment, prolonged survival, and lower mortality in Florida. Therefore, the lack of decreases seen in mortality for these cancers must be rooted in an increase in incidence, which is a worrisome finding. Unfortunately, a common risk factor for both cancers is obesity.[1] Data at the population level shows a trend of increasing prevalence of obesity and transition to a high caloric fatty diet when immigrants settle in the United States.[64,73,74]

Some of the results did not follow known or expected patterns. Breast cancer has protective risk factors associated with fertility patterns[23] that have been shown to change with migration to the United States, including delayed childbearing and a reduction in total number of pregnancies.[75,76] In our study, for Haitian females, breast cancer mortality rates were somewhat higher in Florida than Haiti. Offsetting a possible gain in survival due to screening and more access to quality treatment, the increased mortality among Haitians in Florida may well derive from an increased incidence of breast cancer which may be higher due to diminished fertility and delayed childbearing among other factors. On the other hand, for Jamaican women, breast cancer mortality rates were much lower in Florida than in Jamaica. It is possible that Jamaican women in Florida, who tend to have higher levels of education,[7] may reap the benefit of better health care access. The greater total baseline fertility rate in Haiti than Jamaica (3.1 compared to 2.3 children[77]) as well as higher obesity rates in Jamaica[64] may also play a role in explaining why breast cancer rates in Florida are higher among Jamaican than Haitian women.

For lung cancer, for Haitian males and Jamaican females, rates were significantly higher in Florida than Haiti. Lung cancer has a poor survival prognosis regardless of gender, SES, or race, and even location.[78] Therefore, this difference would suggest an increase in incidence rather than a change in survival. Yet among Jamaican men, lung cancer rates were much lower in Florida than in Jamaica, suggesting an intriguing decreased incidence. It is possible that these results reflect changes in smoking prevalence when immigrants settle in the United States.[79] Given the importance of smoking as a risk factor for many cancers, these changes need to be carefully monitored.

Our study has the usual limitations of descriptive epidemiology. There is a lack of both individual level risk factor data for all subjects as well as group level risk factor data specific to Caribbean-born populations in Florida. We also had some relatively small population sizes, which sometimes resulted in a lack of precision in our mortality rates, particularly for the small OWI group. We attempted to mitigate this by accumulating 5 years of mortality experience and annualizing the rates. Another limitation is that Globocan mortality estimates for 2012 for Haitians are modelled, relying on the last date for which real data were available, which may be several years old.

Our study examines black populations in Florida, which may not be representative of all black populations in the United States. Additionally, in theory, our mortality numbers could reflect a "salmon bias", whereby small numbers of immigrants who are very ill return to their home countries of origin to die, which would artificially lower mortality rates for those born outside the United States in our study. However, the magnitude of this out-migration for Hispanics has been found to be very small,[80] and the literature for this phenomenon among black immigrants in the United States is non-existent.

Relying on birthplace rather than ancestry may result in a small degree of misclassification. Haitian, Jamaican and other West Indian ancestry populations, which may include second generation Caribbeans, are larger than the birthplace populations we used for this study. Some of the people in the US-born blacks category in our study are quite possibly of Haitian, Jamaican or OWI ancestry. However, given the trend of relatively recent immigration for these populations, this would likely only affect cancer sites with mortality in relatively younger age groups, such as cervical cancer. Our Florida mortality data provided information

on Haitian ancestry, but not any other Caribbean ancestry. To test for differences between using birthplace and ancestry, we calculated mortality rates using the Haitian ancestry information and found that the differences in rates were negligible, thus reducing the likelihood of a threat to validity based on misclassification.

Strengths of our study include the very high completeness (99%) of birthplace information among all deaths in the state of Florida, allowing for reliable classification of the different populations, which is unfortunately never achieved in cancer incidence data. We also used detailed denominators based on birthplace available from the American Community Survey.

Overall, cancer mortality rates among black Caribbeans are remarkably low. While there has been much research demonstrating health advantages for Hispanics, our results point to an even greater health advantage for black Caribbeans than Hispanic Caribbeans in Florida. More striking is the markedly worse cancer mortality rates for US-blacks when compared to Caribbean blacks. The low mortality among Caribbean blacks has the effect of improving the overall US cancer rates for blacks. Not surprisingly, of the 17 states with black populations over 1 million, Florida and New York, states with the highest proportions of black Caribbean populations, have the lowest cancer mortality rates for blacks in the United States.[1]

To our knowledge these are the only results available looking at cancer outcomes on a population basis that analyze US-born blacks separately, directly comparing them to Caribbean-born people residing in the United States. The mortality rates presented here will also constitute a baseline for monitoring the cancer burden among Caribbean populations and help the fight against cancer across all majority-black Caribbean nations. Cancer literature is somewhat scarce for the Caribbean region due to a lack of reliable data. Phillips et al. used estimates from Globocan 2002 data to characterize cancer incidence and mortality in the Caribbean nations.[81] However, in a quickly evolving world, these data are possibly now outdated. Fortunately, cancer registration in Jamaica and other Caribbean nations is showing signs of improvement.[46]

The current study highlights once again the need to thoroughly address known racial disparities in cancer risk and outcomes in the United States. To analyze intraracial differences, it is fundamental to have specific and accurate cancer data, including data on immigrant groups. In states with large Caribbean populations, such as Florida and New York, it would be beneficial to have health data on this population collected methodically as has been done for other racial/ethnic subgroups in California and New York City. An active role of the North American Central Cancer Registries Association and the central cancer registries in Florida and New York would greatly improve the knowledge of cancer epidemiology among black populations, especially regarding incidence data. Better understanding of intraracial cancer patterns including the extent to which acculturation impacts cancer incidence, survival, and mortality among black US immigrants will help in targeted US cancer prevention and control efforts.

Conclusions

The US-born black population has the highest cancer mortality risk in the nation — even higher than previously documented when rates for blacks born outside the United States are calculated separately. Continued attention and effort is required to reduce the disproportional burden of cancer in US blacks. On the other hand, a record 3.8 million black immigrants, accounting for 9% of the current black population in the United States,[5] are currently low risk populations for most cancers. It is important to monitor these trends, looking for ways to help all populations acquire protective factors and resist risk factors for cancer. More studies into the mechanisms that would avoid an unfavorable trend towards worse cancer outcomes in Caribbean blacks are necessary. Our study suggests that obesity, a known risk factor for many US blacks, may be an important focus for intervention in Caribbean blacks, especially among females, as immigrants have higher colorectal and endometrial cancer mortality rates in relation to their countries of origin. Targeted screening programs and expanding access to care would also help these immigrant populations. Concurrently, the public health community must clarify and address the reasons for such poor cancer outcomes among US-born blacks so that the interracial gaps can be significantly narrowed.

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