# Cancer Incidence in First Generation U.S. Hispanics: Cubans, Mexicans, Puerto Ricans, and New Latinos

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## Abstract

Background:**The diversity among Hispanics/Latinos, defined by geographic origin (e.g., Mexico, Puerto Rico, Cuba), has been neglected when assessing cancer morbidity. For the first time in the United States, we estimated cancer rates for Cubans, Mexicans, Puerto Ricans, and other Latinos, and analyzed changes in cancer risk between Hispanics in their countries of origin, U.S. Hispanics in Florida, and non-Hispanic Whites in Florida.**

Methods: **Florida cancer registry (1999-2001) and the 2000 U.S. Census population data were used. The Hispanic Origin Identification Algorithm was applied to establish Hispanic ethnicity and subpopulation.**

Results: **The cancer rate of 537/100,000 person-years (95% confidence interval, 522.5-552.5) for Hispanic males in Florida was lower than Whites (601; 595.4-606.9). Among women, these rates were 376 (365.6-387.1) and 460 (455.6-465.4), respectively. Among Florida Hispanics, Puerto Ricans had the highest rates, followed by Cubans. Mexicans had the lowest rates. Rates for Hispanics in Florida were at least 40% higher than Hispanics in their countries of origin, as reported by the IARC.**

Conclusion: **Substantial variability in cancer rates occurs among Hispanic subpopulations. Cubans, unlike other Hispanics, were comparable with Whites, especially for low rates of cervical and stomach cancers. Despite being overwhelmingly first generation in the U.S. mainland, Puerto Ricans and Cubans in Florida showed rates of colorectal, endometrial, and prostate cancers similar to Whites in Florida. Because rates are markedly lower in their countries of origin, the increased risk for cancer among Cubans, Mexicans, and Puerto Ricans who move to the United States should be further studied.** (Cancer Epidemiol Biomarkers Prev 2009;18(8):2162–9)

## Introduction

Hispanics/Latinos in the United States share a common language, immigration experience, and a culture with attitudes and values that tend to differ from those of the mainstream English-language culture of non-Hispanic Whites (1). Genetically, they descend from indigenous American, European, and African populations (2). Normally classified as a single ethnic group, Hispanics are, however, heterogeneous from cultural, socioeconomic, and genetic perspectives, and represent a wide variety of national subpopulations, ethnic, and cultural groups with a full spectrum of social class (1).

U.S. Hispanics have generally shown lower cancer incidence than non-Hispanic U.S. Whites, particularly for common cancer sites, including breast, colorectal, prostate, and lung cancers, but higher incidence of cancers associated with infections and lower socioeconomic status, typically cervical, liver, and stomach cancers (3-5). However, the reported cancer statistics likely mask the variation in cancer occurrence for different Hispanic subpopulations: Cubans, Mexicans, Puerto Ricans, and others. Thus far, there have been no reliable reports on cancer incidence rates for these subpopulations in the United States (1, 5). The most comprehensive study estimated proportional incidence ratios, but 62% of the cancer cases had unknown Hispanic subpopulation (3). In addition, proportional incidence ratios depend on the relative frequency of each cancer and therefore do not fully characterize the occurrence of cancer in these populations.

In 2000, Florida was home to 2.7 million Hispanics being the first state in number of Cubans, second in Puerto Ricans, fourth in South and Central Americans, and fifth in Mexicans. As such, Florida provides a unique opportunity for the surveillance of cancer in Hispanic subpopulations (6). In this study, we analyzed cancer incidence rates for Hispanics in Florida and compared them with non-Hispanic Whites and non-Hispanic Blacks.

Additionally and for the first time, we estimated the cancer incidence rates for Mexicans, Puerto Ricans, Cubans, and New Latinos living in a part of the mainland United States, Florida. New Latinos includes Hispanics from all countries in the Americas with Spanish as the official language, except Mexico, Puerto Rico, and Cuba (7). Finally, we analyzed the change in cancer rates between Mexico, Puerto Rico, and Cuba, their corresponding populations

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in Florida, and the reference group in the U.S. mainland, non-Hispanic Whites.

## Materials and Methods

This study used data from all 301,944 cancer cases among Florida residents, diagnosed between 1999 and 2001, and reported to the Florida Cancer Data System. The Florida Cancer Data System is the legislatively mandated, population based central cancer registry for Florida. Cases in Florida Cancer Data System are abstracted from patient medical records in hospitals, free-standing ambulatory surgical facilities, radiation therapy facilities, private physicians, and death certificates. The estimated overall completeness is >95%, as determined by external quality control audits. The Florida Cancer Data System is part of the Centers for Disease Control National Program of Cancer Registries. It is nationally certified by the North American Association of Central Cancer Registries at its highest level (gold certification) for meeting/exceeding standards for completeness, timeliness, and quality. This study was approved by the University of Miami and the Florida Department of Health institutional review boards.

**Population.** Race and ethnicity were combined to produce four mutually exclusive racial/ethnic population groups: non-Hispanic White (White), non-Hispanic Black (Black), mixed race and other non-Hispanics, and Hispanics (all races). In 2000, the total population of Florida was 16 million: 65% White (10.5 million), 14% Black (2.3 million), 4% of non-Hispanic other or mixed race (0.5 million), and 17% Hispanic (2.7 million). Rates for non-Hispanics of other or mixed race were not studied. Among Hispanics, four major subpopulations were studied: Mexicans (14%, 0.38 million), Puerto Ricans (19%, 0.50 million), Cubans (33%, 0.87 million), and the Florida New Latinos (34%, 0.94 million; refs. 8, 9). Because of limitations in cancer registry coding and census data (e.g., Central and South Americans are currently considered in the same category in registries), the New Latino group, although still a heterogeneous grouping, is currently the best possible option to study the remaining Hispanic cases. Because of constraints in terms of census data, this study included those born in Spain, who are by definition also Hispanic, in the Florida New Latino group. In 2000, the Florida New Latino Group was very diverse (50% from South America, 35% from Central America, 12% from the Dominican Republic, and 3% from Spain; ref. 8).

Age- and gender-specific population figures for Florida for each racial/ethnic group and for Hispanic subpopulations (Mexicans, Puerto Ricans, Cubans, and New Latinos) were obtained from the Census 2000 (8). The U.S. Census 2000 asked specifically the Hispanic origin for three subpopulations only: Mexican, Puerto Rican, and Cuban. Moreover, the wording and format of this question may have influenced respondents in their answers. According to a study conducted by the Census Bureau based on birthplace and ancestry questions, the result was an undercount for some subpopulations and a sizeable proportion of Hispanics without a specific subpopulation (9). The denominators used here were adjusted, based on the results of that work, by adding the specific proportions of Mexicans (4.1%), Puerto Ricans (3.8%), and Cubans (4.2%) missed by the Census in Florida to each of the 18 age groups used in the calculation of rates (9). All remaining Hispanics were used in the denominator for the New Latino group.

**Incidence Data.** All cases of invasive cancers, except non-melanoma skin, diagnosed among Floridians during a 3-year period were used. Primary cancer site and histology data were coded according to the International Classification of Diseases for Oncology edition in use at the time of diagnosis, converted to the third edition, and categorized according to SEER (Surveillance Epidemiology End Results) site groups (10, 11). Because denominators for Hispanic subpopulations from the census were only available for year 2000, incidence data for diagnosis years 1999 to 2001 were used to most closely match the population (denominator) data.

**Hispanic Assignment.** The Hispanic Origin Identification Algorithm (12) was used for assignment of Hispanic subpopulation and ethnicity. The Hispanic Origin Identification Algorithm relies on birthplace, ethnicity, and surname obtained from the registry records and from death certificates. The algorithm has been described and validated for use with Florida cancer data (13). For the study period, 32% of Hispanic cancer cases lacked a specific subpopulation (Mexican, Puerto Rican, Cuban, or New Latino), even after applying the Hispanic Origin Identification Algorithm. For these cases of unknown Hispanic subpopulation, we imputed values based on proportional allocation. The health districts of Florida were grouped into three regions, North, Central, and South, based on geographic contiguity and uniformity of the proportion of the Hispanic subpopulations in the state. For the purpose of allocation only, age was divided into four groups (0-24, 25-54, 55-74, $\geq$75). For each combination of age group, gender, region, and cancer site, we assumed that the distribution of Hispanic subpopulation was equivalent between those with missing and those with known Hispanic subpopulation. For example, Mr. X is of Hispanic ethnicity with unknown subpopulation, is 65 y old, resides in Central Florida, and has esophageal cancer. His one cancer case was counted as 0.2 Mexican, 0.3 Puerto Rican, 0.4 Cuban, and 0.1 New Latino following the proportion of cases of known Hispanic subpopulation for males in Central Florida in that age group, with esophageal cancer.

**Rates.** Cancer incidence rates were calculated for 1999 to 2001 per 100,000 and age adjusted by the direct method, using 18 age groups (0-4, 5-9,…, 80-84, $\geq$85) to the 2000 U.S. standard population. For non-Hispanic White, non-Hispanic Black, and Hispanics as a whole, the rates are the actual rates. For the Hispanic subpopulations, the rates are based on 68% of subjects with known specific Hispanic subpopulation and 32% being imputed as described above. Confidence intervals were calculated according to the Tiwari method (14).

**Comparison With Rates in Countries of Origin.** Most of the total Florida Hispanic population, 73%, is foreign born (15). This does not include the percentage of Puerto Ricans born in Puerto Rico but who migrated to Florida. Because cancer is more common in older age groups, Florida Hispanics diagnosed with cancer are overwhelmingly first generation in the United States. In fact, among those with a known birthplace, 88% of Hispanic cancer cases in Florida in 1999 to 2001 were born outside the United States or in Puerto Rico.

In the epidemiologic context, this enables a comparison to be made between Hispanic subjects of the same generation, that is, those who stayed in their countries of origin and those who moved to Florida at some point in their lives. Therefore, we calculated the rates for each Hispanic subpopulation in Florida (age adjusted for the world standard population, 18 age groups) and compared them with the estimated rates for 2002 published by the IARC for Mexico, Puerto Rico, and Cuba (16). IARC does not provide estimates for the remaining Hispanic countries as a whole, so New Latinos were excluded from this specific analysis. We analyzed all cancers together and the four most common cancers in each sex, as well as cancers with reported increased incidence among Hispanics: stomach, liver, and cervix. The term endometrial cancer is used interchangeably with cancer of the uterine corpus. For ease of discussion, Puerto Rico is referred to as a country throughout the text.

## Results

Overall, 301,994 cancer cases were diagnosed in Florida residents for diagnosis years 1999 to 2001. The Hispanic Origin Identification Algorithm identified a total of 30,238 Hispanic subjects, 68% with a specific subgroup and 32% with an unknown subgroup. All 30,238 were used for calculation of rates for Hispanics as a whole and for Hispanic subgroups.

The overall age-adjusted incidence rates for all Hispanics were 537/100,000 person-years in men and 376/100,000 in women. The total cancers rate in Hispanic men was 11% below Whites (601/100,000) and 17% below Blacks (650/100,000; Table 1). In women, the total cancers rate among Hispanics was 18% below Whites (460/100,000), and 2% below Blacks (382/100,000; Table 2).

**Hispanics, Whites, and Blacks.** Prostate, lung, and colorectal cancers were the top three incident cancers for all males, regardless of race and ethnicity. Bladder cancer followed for Hispanics and Whites, but stomach cancer was the fourth most common cancer for Black men. Among Florida women, breast, lung, colorectal, and endometrial cancer were the most common cancers. Cervical cancer was the fifth most common in Blacks, sixth in Hispanics, and only tenth among White women.

Stomach and liver cancers were higher in Hispanics than Whites for both sexes. Kaposi sarcoma was higher among Hispanic men, and cervical, gall bladder cancers, and myeloma were higher among Hispanic women than Whites (Tables 1 and 2). Substantially lower rates among Hispanics compared with Whites were found for lung cancer and skin melanoma for both sexes. Other significantly decreased rates among Hispanics compared with Whites included chronic lymphocytic leukemia for both sexes, esophageal and testicular cancer for men, and breast and ovarian cancers for women.

Unlike most previous studies (3-5), rates for prostate, colorectal, and endometrial cancers among Hispanics were similar to Whites. Rates of liver cancer, gall bladder cancer, and acute lymphocytic leukemia among Hispanics were higher than Whites and Blacks. Interestingly, stomach and cervical cancers, traditionally associated with

**Table 1. Cancer incidence rates and 95% confidence intervals among Hispanic, non-Hispanic White, and non-Hispanic Black men, and respective incidence ratios. Florida 1999 to 2001**

| | Hispanics | NH Whites | NH Blacks | IR (Hispanics/NH Whites) | IR (Hispanics/NH Blacks) |
|---|---|---|---|---|---|
| All sites | 537.4 (522.5-552.5) | 601.1 (595.4-606.9) | 650.4 (629.9-671.4) | 0.9 | 0.8 |
| Prostate | 164.0 (155.9-172.4) | 162.5 (159.6-165.4) | 259.1 (246.2-272.6) | 1 | 0.6 |
| Lung | 71.7 (66.3-77.5) | 102.6 (100.3-105.0) | 104.9 (96.6-113.6) | 0.7 | 0.7 |
| Colon and rectum | 67.8 (62.5-73.5) | 68.0 (66.1-70.0) | 72.6 (65.7-80.0) | 1 | 0.9 |
| Bladder | 27.7 (24.3-31.4) | 29.9 (28.7-31.2) | 11.9 (9.1-15.1) | 0.9 | 2.3 |
| Non-Hodgkin's lymphoma | 22.0 (19.2-25.1) | 24.5 (23.3-25.7) | 17.4 (14.5-20.6) | 0.9 | 1.3 |
| Oral cavity and pharynx | 17.8 (15.2-20.7) | 21.1 (20.0-22.3) | 18.0 (15.0-21.5) | 0.8 | 1 |
| Kidney | 17.3 (14.7-20.1) | 18.0 (17.0-19.1) | 14.7 (11.9-17.9) | 1 | 1.2 |
| Leukemia | 16.9 (14.4-19.7) | 19.8 (18.7-20.9) | 12.8 (10.1-16.0) | 0.9 | 1.3 |
| Acute lymphocytic leukemia | 2.7 (1.8-3.7) | 1.9 (1.5-2.3) | 1.1 (0.6-2.1) | 1.4 | 2.5 |
| Chronic lymphoid leukemia | 4.6 (3.3-6.3) | 7.6 (7.0-8.3) | 4.4 (2.8-6.6) | 0.6 | 1 |
| Acute myeloid leukemia | 4.9 (3.6-6.5) | 5.1 (4.6-5.7) | 3.4 (2.1-5.2) | 1 | 1.4 |
| Chronic myeloid leukemia | 2.4 (1.5-3.6) | 2.2 (1.8-2.5) | 2.2 (1.2-3.6) | 1.1 | 1.1 |
| Stomach | 13.4 (11.1-16.0) | 9.2 (8.5-9.9) | 19.3 (15.7-23.3) | 1.5 | 0.7 |
| Pancreas | 12.1 (9.9-14.6) | 13.0 (12.2-13.9) | 15.2 (12.1-18.8) | 0.9 | 0.8 |
| Liver | 11.6 (9.5-14.0) | 6.9 (6.3-7.6) | 8.8 (6.7-11.3) | 1.7 | 1.3 |
| Larynx | 11.0 (9.0-13.3) | 9.8 (9.1-10.6) | 12.0 (9.5-15.1) | 1.1 | 0.9 |
| Brain and other nervous system | 8.0 (6.4-9.9) | 8.6 (7.9-9.4) | 5.0 (3.5-6.9) | 0.9 | 1.6 |
| Melanoma of the skin | 6.7 (5.2-8.5) | 29.7 (28.3-31.0) | 1.3 (0.6-2.6) | 0.2 | 5.2 |
| Myeloma | 6.2 (4.7-8.0) | 6.7 (6.1-7.4) | 13.0 (10.2-16.2) | 0.9 | 0.5 |
| Esophagus | 5.6 (4.2-7.3) | 8.9 (8.2-9.7) | 12.5 (9.9-15.6) | 0.6 | 0.4 |
| Hodgkin disease | 4.1 (3.0-5.4) | 3.4 (2.9-3.9) | 2.3 (1.4-3.5) | 1.2 | 1.8 |
| Thyroid | 4.0 (2.9-5.4) | 4.3 (3.7-4.8) | 2.0 (1.1-3.3) | 0.9 | 2 |
| Testis | 3.6 (2.7-4.7) | 6.4 (5.7-7.2) | 1.4 (0.7-2.4) | 0.6 | 2.6 |
| Kaposi sarcoma | 2.4 (1.6-3.4) | 1.3 (1.0-1.6) | 2.6 (1.7-3.9) | 1.8 | 0.9 |
| Anus | 1.9 (1.1-3.0) | 1.5 (1.2-1.8) | 1.5 (0.8-2.7) | 1.3 | 1.3 |
| Gall bladder | 1.4 (0.7-2.4) | 0.7 (0.5-0.9) | 1.0 (0.3-2.2) | 2 | 1.4 |
| Penis | 1.4 (0.7-2.4) | 0.8 (0.6-1.0) | 1.2 (0.5-2.5) | 1.8 | 1.2 |

NOTE: Rates are average annual per 100,000 age adjusted to the U.S. 2000 Standard Population. Hispanic ethnicity was derived from the Hispanic Origin Identification Algorithm.
Abbreviations: IR, incidence ratio; NH, non-Hispanic.

**Table 2. Cancer incidence rates and 95% confidence intervals among Hispanic, non-Hispanic White, and non-Hispanic Black women, and respective incidence ratios. Florida 1999 to 2001**

| | Hispanics | NH Whites | NH Blacks | IR (Hispanics/ NH Whites) | IR (Hispanics/ NH Blacks) |
|---|---|---|---|---|---|
| All sites | 376.2 (365.6-387.1) | 460.4 (455.6-465.4) | 382.0 (369.4-395.0) | 0.8 | 1 |
| Breast | 106.4 (100.8-112.3) | 140.4 (137.6-143.2) | 104.9 (98.5-111.7) | 0.8 | 1 |
| Colon and rectum | 52.9 (49.0-57.1) | 48.9 (47.4-50.4) | 54.6 (49.8-59.7) | 1.1 | 1 |
| Lung | 29.7 (26.7-32.8) | 69.8 (68.0-71.6) | 41.3 (37.2-45.8) | 0.4 | 0.7 |
| Corpus uteri | 20.2 (17.8-22.8) | 21.5 (20.4-22.5) | 20.7 (17.8-23.9) | 0.9 | 1 |
| Non-Hodgkin's lymphoma | 14.8 (12.8-17.1) | 17.0 (16.1-18.0) | 12.3 (10.2-14.8) | 0.9 | 1.2 |
| Ovary | 14.6 (12.6-16.9) | 18.8 (17.8-19.8) | 11.6 (9.5-14.0) | 0.8 | 1.3 |
| Cervix | 14.0 (12.0-16.2) | 10.5 (9.7-11.4) | 16.9 (14.4-19.6) | 1.3 | 0.8 |
| Thyroid | 12.8 (10.9-14.9) | 10.9 (10.1-11.8) | 7.1 (5.5-8.9) | 1.2 | 1.8 |
| Leukemia | 10.7 (9.0-12.8) | 11.6 (10.8-12.4) | 9.7 (7.8-12.0) | 0.9 | 1.1 |
| Acute lymphocytic leukemia | 1.6 (1.0-2.5) | 1.3 (1.0-1.7) | 0.8 (0.4-1.6) | 1.2 | 2 |
| Chronic lymphocytic leukemia | 2.4 (1.6-3.4) | 4.2 (3.8-4.7) | 2.5 (1.5-3.8) | 0.6 | 1 |
| Acute myeloid leukemia | 3.5 (2.6-4.7) | 3.2 (2.8-3.6) | 3.2 (2.2-4.6) | 1.1 | 1.1 |
| Chronic myeloid leukemia | 1.3 (0.7-2.1) | 1.3 (1.1-1.6) | 1.3 (0.6-2.2) | 1 | 1 |
| Pancreas | 10.3 (8.6-12.2) | 9.8 (9.2-10.5) | 12.5 (10.2-15.1) | 1.1 | 0.8 |
| Kidney | 7.7 (6.2-9.4) | 8.7 (8.0-9.3) | 7.2 (5.5-9.1) | 0.9 | 1.1 |
| Stomach | 6.7 (5.3-8.3) | 3.9 (3.5-4.4) | 9.6 (7.7-12.0) | 1.7 | 0.7 |
| Oral cavity and pharynx | 6.6 (5.3-8.2) | 8.2 (7.6-8.9) | 6.6 (5.0-8.4) | 0.8 | 1 |
| Brain and other nervous system | 6.3 (5.0-7.8) | 6.3 (5.6-6.9) | 3.5 (2.5-4.9) | 1 | 1.8 |
| Bladder | 6.1 (4.8-7.7) | 7.6 (7.0-8.2) | 5.2 (3.7-8.0) | 0.8 | 1.2 |
| Myeloma | 5.8 (4.6-7.3) | 4.1 (3.7-4.5) | 8.8 (6.9-11.0) | 1.4 | 0.7 |
| Liver | 4.7 (3.6-6.1) | 2.5 (2.2-2.9) | 3.3 (2.2-4.6) | 1.9 | 1.4 |
| Melanoma of the skin | 4.5 (3.4-5.8) | 17.7 (16.7-18.8) | 1.6 (0.9-2.7) | 0.3 | 2.8 |
| Anus | 2.8 (1.9-3.9) | 2.0 (1.7-2.4) | 1.3 (0.7-2.3) | 1.4 | 2.2 |
| Hodgkin disease | 2.3 (1.5-3.2) | 2.6 (2.2-3.1) | 1.7 (1.1-2.7) | 0.9 | 1.4 |
| Gall bladder | 2.1 (1.4-3.1) | 1.1 (0.9-1.3) | 1.9 (1.1-3.0) | 1.9 | 1.1 |
| Vulva | 1.7 (1.1-2.6) | 2.8 (2.4-3.2) | 1.7 (0.9-2.7) | 0.6 | 1 |
| Esophagus | 1.5 (0.9-2.4) | 2.3 (2.0-2.7) | 3.8 (2.7-5.4) | 0.7 | 0.4 |
| Vagina | 1.1 (0.6-1.8) | 0.7 (0.5-0.9) | 1.1 (0.5-2.0) | 1.6 | 1 |

NOTE: Rates are average annual per 100,000 age adjusted to the U.S. 2000 Standard Population. Hispanic ethnicity was derived from the Hispanic Origin Identification Algorithm.

Hispanic ethnicity, were more common in Blacks than among Hispanics and Whites.

During 1999 to 2001, of 30,238 cases diagnosed among Hispanics, an estimated 1,229 cancer cases (4%) occurred among Mexicans, 5,010 (17%) in Puerto Ricans, 16,755 (55%) in Cubans, and 7,244 (24%) among New Latinos. All-cancers rates in both sexes were highest in Puerto Ricans, followed by Cubans and then New Latinos; the lowest rates were found in Mexicans (Tables 3 and 4). The range in cancer rates for Hispanics was large, with Puerto Ricans having much higher rates than Mexicans, 53% higher rates among males and 30% higher rates among females.

**Cubans.** Among Hispanics, Cuban men were the most afflicted by cancers with either a strong (lung, larynx) or moderate association with tobacco (bladder, kidney, and pancreas). The highest laryngeal rates of any race/ethnicity were observed among Cuban men. This tobacco-related cancer excess was not observed for oral and esophageal cancers, in which alcohol consumption plays a role, nor was it seen among Cuban women. In contrast to all other Hispanics, cervical and stomach cancers rates among Cubans were low, similar to those of Whites. Compared with Whites, Cubans in Florida showed higher rates of liver cancer but lower rates of lung cancer in men and breast cancer in women. Cuban women had the highest rate of colorectal cancer among all females, regardless of race/ethnicity.

**Mexicans.** Mexicans had the lowest cancer incidence rates of all Hispanic populations. For non-tobacco-related cancers, prostate, breast, endometrial, and colorectal cancers, Mexican rates were remarkably low. For cancers generally common among minorities, for example, stomach, cervix, and liver, rates for Mexicans in Florida were higher than those in Whites.

**Puerto Ricans.** With a few exceptions, Puerto Ricans in Florida consistently showed the highest cancer rates of all Hispanic subpopulations. For most cancers, rates were close to those of Whites. Lung cancer and melanoma in both sexes and female breast were notable exceptions, with much lower rates in Puerto Ricans than in Whites. As expected, Puerto Ricans had high rates of cervix, stomach, and liver, typical of Hispanic countries. Puerto Rican males also showed the highest rates for two alcohol-related cancers, oral cavity and liver cancers, among all populations analyzed.

**New Latinos.** New Latinos combine populations with relatively high (South Americans and Spaniards) and low (Central Americans and Dominicans) economic and educational indicators (17). Among all populations analyzed, New Latinos had the lowest rates of lung cancer and the highest rates of thyroid cancer. Like other Hispanics, they showed high rates of stomach, cervix, and liver cancers.

**Florida and Country of Origin.** All-cancer incidence for Mexicans, Puerto Ricans, and Cubans in Florida was at least 40% higher compared with their compatriots in their home countries (Table 5; Figs. 1 and 2). The higher incidence among Hispanics in the United States occurred for all common cancers: breast, prostate, colorectal, and lung. Particularly for lung cancer, Mexican and Puerto Rican rates in Florida were four times higher in women and double in men than rates in their home countries

(Figs. 1 and 2). Conversely, higher incidence of stomach cancer in both sexes and liver cancer in females was seen in the home countries for all subpopulations.

## Discussion

To our knowledge, our study is the first in the United States to estimate incidence rates by Hispanic subpopulation. Our research shows that Hispanics had lower all-cancers rates than non-Hispanic populations, mostly due to lower rates of lung and breast cancers. These findings agree with other reports (3-5) and with the purported Latino Health Paradox (18).

However, our study also suggests that Mexicans are a lower risk population compared with Puerto Ricans or Cubans, which are higher risk populations. Moreover, Cubans are a distinct group with respect to cancer incidence among Hispanics, their cancer patterns resembling those of Whites in Florida, particularly for the low incidence of stomach and cervical cancers. Their higher educational attainment and income in relation to Mexicans and Puerto Ricans (17) may be driving their unique cancer profile.

Cancer rates did not show a consistent pattern associated with economic deprivation. Mexicans had consistently low rates for the common cancers occurring in the United States, whereas Puerto Ricans showed rates close to mainland Whites for many cancers, plus the additional burden of high rates for cervical, liver, and stomach cancers. These two populations are both economically deprived (17). Puerto Ricans, as U.S. citizens, have easier access to welfare and healthcare compared with Mexicans. However, this did not translate into a lower cancer burden.

Comparisons for selected cancers (Figs. 1 and 2) between rates in Florida and countries of origin were made for Cubans, Mexicans, and Puerto Ricans. Overall, Florida Hispanic rates were intermediate between rates in Hispanic countries and those of non-Hispanic Whites in Florida. This is as expected in the epidemiologic context in which immigrants tend to gradually acquire the disease profile of the host population. Accordingly, in the case of Florida, an actual increase in rates among Florida Hispanics compared with their countries of origin was observed for common cancers like lung, breast, and prostate. Changes in tobacco smoking rates among immigrants (19) may partly explain the increase in lung cancer. Changes in reproductive patterns, such as less parity and higher age at first birth or higher use of hormone replacement therapy, may affect Hispanic rates of breast cancer. Likewise, a higher use of the prostate-specific antigen test in the United States may partially explain the higher incidence of prostate cancer among Cubans and Mexicans in the United States compared with their countries of origin.

Increased rates were also observed for colorectal cancer and endometrial cancer among Hispanics in Florida compared with their countries of origin. However, for Cubans and Puerto Ricans in Florida, rates were similar to Whites in Florida, rather than intermediate between country of origin and Florida. Among other risk factors, these cancers are related to diet, animal fat consumption, (20) and obesity (21). Cancer screening for colorectal cancer is unlikely to play a major role in the overall rates because, in the general population, most cases of colorectal cancer are still diagnosed as symptoms arise (22). As the overwhelming majority of the Hispanic cancer cases in Florida are foreign born, this change in patterns of colorectal and endometrial cancers is remarkable and suggests an acquisition of increased risk within the same generation rather than among subsequent generations.

In contrast to most cancers, for stomach cancer, which is related to methods of fresh food preserving, vitamin C

**Table 3. Cancer incidence rates and respective 95% confidence intervals for males in different Hispanic subpopulations and incidence ratios between each Hispanic subpopulation and non-Hispanic Whites. Florida 1999 to 2001**

| | Cuban | IR Cuban/ NH Whites | Mexican | IR Mexican/ NH Whites | New Latinos | IR New Latinos/ NH Whites | Puerto Rican | IR Puerto Rican/ NH Whites |
|---|---|---|---|---|---|---|---|---|
| All sites | 557.8 (537.9-578.3) | 0.9 | 376.8 (315.2-445.4) | 0.6 | 462.6 (433.3-493.2) | 0.8 | 574.8 (533.9-617.8) | 1 |
| Prostate | 163.9 (153.5-174.8) | 1 | 91.9 (62.1-129.1) | 0.6 | 169.3 (151.5-188.3) | 1 | 162.5 (141.3-185.8) | 1 |
| Lung | 82.6 (75.1-90.8) | 0.8 | 61.5 (37.4-93.2) | 0.6 | 43.1 (33.9-53.7) | 0.4 | 75.0 (60.5-91.6) | 0.7 |
| Colon and rectum | 72.4 (65.4-80.1) | 1.1 | 33.0 (17.4-55.3) | 0.5 | 48.5 (39.1-59.3) | 0.7 | 79.5 (64.2-97.0) | 1.2 |
| Bladder | 32.8 (28.1-38.2) | 1.1 | 15.6 (5.3-33.6) | 0.5 | 19.4 (13.3-27.0) | 0.6 | 20.3 (12.6-30.4) | 0.7 |
| Non-Hodgkin's lymphoma | 22.6 (18.6-27.3) | 0.9 | 21.8 (9.6-40.5) | 0.9 | 19.1 (14.0-25.2) | 0.8 | 25.3 (17.6-35.1) | 1 |
| Kidney | 18.3 (14.8-22.4) | 1 | 13.8 (4.6-29.8) | 0.8 | 15.9 (11.0-22.1) | 0.9 | 17.7 (11.2-26.4) | 1 |
| Oral cavity and pharynx | 15.9 (12.4-20.1) | 0.8 | 9.7 (1.9-22.1) | 0.5 | 11.3 (7.0-17.0) | 0.5 | 22.2 (12.1-28.6) | 1.1 |
| Leukemia | 15.5 (12.2-19.4) | 0.8 | 15.1 (5.3-31.7) | 0.8 | 14.7 (10.2-20.4) | 0.7 | 20.2 (13.4-29.0) | 1 |
| Stomach | 9.7 (7.2-12.9) | 1.1 | 14.0 (4.5-30.5) | 1.5 | 16.8 (11.6-23.2) | 1.8 | 21.3 (13.6-31.3) | 2.3 |
| Pancreas | 12.6 (9.8-16.1) | 1 | 10.0 (2.0-25.8) | 0.8 | 10.2 (6.3-15.5) | 0.8 | 11.6 (6.2-19.3) | 0.9 |
| Liver | 10.1 (7.8-13.3) | 1.5 | 10.8 (2.8-25.9) | 1.6 | 9.1 (5.4-14.3) | 1.3 | 19.2 (12.8-27.4) | 2.8 |
| Larynx | 13.8 (10.8-17.4) | 1.4 | 3.6 (0.1-14.6) | 0.4 | 7.9 (4.5-12.8) | 0.8 | 10.0 (5.3-16.7) | 1 |
| Brain | 8.1 (5.7-11.2) | 0.9 | 4.8 (1.2-13.3) | 0.6 | 6.6 (4.1-10.0) | 0.8 | 8.7 (5.0-14.1) | 1 |
| Melanoma of the skin | 6.9 (4.8-9.6) | 0.2 | 1.5 (0.0-8.5) | 0.1 | 7.9 (4.6-12.6) | 0.3 | 5.4 (2.2-10.7) | 0.2 |
| Myeloma | 4.9 (3.2-7.3) | 0.7 | 7.1 (1.2-20.0) | 1.1 | 7.3 (4.0-12.0) | 1.1 | 8.7 (4.4-15.2) | 1.3 |
| Esophagus | 5.2 (3.5-7.6) | 0.6 | 8.9 (1.9-23.1) | 1 | 4.1 (1.9-7.6) | 0.5 | 7.5 (3.4-13.3) | 0.8 |
| Thyroid | 4.4 (2.7-6.7) | 1 | 3.1 (0.2-11.9) | 0.7 | 5.5 (3.0-9.1) | 1.3 | 2.4 (0.7-6.0) | 0.6 |

NOTE: Rates are average annual per 100,000 age adjusted to the U.S. 2000 Standard Population. Hispanic subpopulation was derived from the Hispanic Origin Identification Algorithm.

**Table 4. Cancer incidence rates and respective 95% confidence intervals for females in different Hispanic subpopulations and incidence ratios between each Hispanic subpopulation and non-Hispanic Whites. Florida 1999 to 2001**

| | Cuban | IR Cuban/ NH Whites | Mexican | IR Mexican/ NH Whites | New Latinos | IR New Latinos/ NH Whites | Puerto Rican | IR Puerto Rican/NH Whites |
|---|---|---|---|---|---|---|---|---|
| All sites | 380.8 (358.6-403.8) | 0.8 | 318.0 (276.9-363.6) | 0.7 | 338.3 (321.1-356.2) | 0.7 | 412.4 (387.7-438.4) | 0.9 |
| Breast | 108.0 (96.7-120.3) | 0.8 | 71.9 (53.1-95.2) | 0.5 | 97.8 (88.4-107.9) | 0.7 | 116.9 (103.7-131.4) | 0.8 |
| Colon and rectum | 62.6 (53.6-72.6) | 1.3 | 31.9 (21.4-46.4) | 0.7 | 37.5 (32.3-43.4) | 0.8 | 49.7 (41.6-59.0) | 1 |
| Lung | 30.2 (24.1-37.3) | 0.4 | 43.3 (31.6-58.7) | 0.6 | 22.3 (18.2-27.0) | 0.3 | 38.9 (31.7-47.3) | 0.6 |
| Corpus uteri | 21.6 (16.5-27.5) | 1 | 15.1 (7.2-27.8) | 0.7 | 16.3 (12.7-20.7) | 0.8 | 21.1 (15.7-27.8) | 1 |
| Non-Hodgkin's lymphoma | 15.6 (11.4-20.6) | 0.9 | 13.2 (6.6-24.2) | 0.8 | 12.8 (9.6-16.6) | 0.8 | 17.8 (13.0-24.0) | 1 |
| Ovary | 13.9 (10.0-18.6) | 0.7 | 10.2 (3.4-22.8) | 0.5 | 14.7 (11.3-18.9) | 0.8 | 17.8 (12.9-23.9) | 0.9 |
| Cervix | 10.8 (7.6-14.7) | 1 | 16.4 (6.9-31.8) | 1.6 | 15.9 (12.1-20.6) | 1.5 | 16.0 (11.0-22.3) | 1.5 |
| Thyroid | 10.4 (7.3-14.4) | 1 | 7.7 (1.2-22.0) | 0.7 | 16.3 (12.3-21.1) | 1.5 | 9.4 (5.7-14.6) | 0.9 |
| Leukemia | 11.5 (7.9-15.9) | 1 | 13.2 (4.7-27.8) | 1.1 | 7.8 (5.4-10.9) | 0.7 | 10.8 (7.1-15.9) | 0.9 |
| Pancreas | 10.6 (7.0-15.2) | 1.1 | 11.4 (5.7-21.3) | 1.2 | 8.4 (6.1-11.4) | 0.9 | 13.0 (9.2-18.1) | 1.3 |
| Kidney | 7.6 (4.7-11.4) | 0.9 | 9.2 (3.2-20.4) | 1.1 | 6.9 (4.6-9.9) | 0.8 | 7.0 (4.0-11.2) | 0.8 |
| Stomach | 4.7 (2.5-7.9) | 1.2 | 6.8 (3.0-14.8) | 1.7 | 9.7 (7.1-12.9) | 2.5 | 9.4 (6.1-13.9) | 2.4 |
| Oral cavity and pharynx | 7.4 (4.6-11.1) | 0.9 | 4.3 (1.1-12.4) | 0.5 | 5.6 (3.6-8.4) | 0.7 | 6.0 (3.4-9.8) | 0.7 |
| Brain | 6.2 (3.8-9.3) | 1 | 9.8 (2.8-23.0) | 1.6 | 5.2 (3.2-8.0) | 0.8 | 7.3 (4.3-11.7) | 1.2 |
| Bladder | 6.0 (3.4-9.6) | 0.8 | 6.2 (2.4-14.3) | 0.8 | 5.4 (3.6-7.9) | 0.7 | 7.5 (4.7-11.6) | 1 |
| Myeloma | 5.0 (2.7-8.3) | 1.2 | 4.7 (1.4-12.7) | 1.1 | 6.7 (4.6-9.4) | 1.6 | 7.4 (4.5-11.6) | 1.8 |
| Liver | 4.8 (2.5-8.0) | 1.9 | 5.0 (1.1-14.4) | 2 | 3.9 (2.4-6.1) | 1.6 | 5.1 (2.9-8.6) | 2 |
| Melanoma of the skin | 5.1 (2.9-8.1) | 0.3 | 3.7 (0.5-12.4) | 0.2 | 4.3 (2.5-6.9) | 0.2 | 4.1 (2.0-7.6) | 0.2 |

NOTE: Rates are average annual per 100,000 age adjusted to the U.S. 2000 Standard Population. Hispanic subpopulation was derived from the Hispanic Origin Identification Algorithm.

consumption, salting, and infection by *Helicobacter pylori* (23), rates among U.S. Hispanic subpopulations were lower than in the respective countries of origin.

For liver cancer, rates were lower for all female Hispanics in Florida. In males, however, rates increase from the countries of origin to Florida. This variation is interesting because a higher incidence of liver cancer among U.S.-born Hispanics compared with Hispanic immigrant men has been reported in Texas (24). Liver cancer is strongly associated with infection by hepatitis B and C, aflatoxins, and heavy alcohol intake (25). The increased risk for hepatocellular carcinoma in many world populations has often been attributed to hepatitis B infection acquired at birth. However, given the diverging rates across gender observed for Florida Hispanics compared with their countries of origin, there may be additional reasons for the high risk for liver cancer among Hispanics. One hypothesis is that male immigrants may adopt less healthy lifestyles (e.g., i.v. drug use and subsequent viral hepatitis B and C or increased alcohol use) compared with females, but further research is needed.

Cervical cancer rates were lower for Mexicans in Florida than in Mexico, possibly because of increased access to screening in the United States. Cervical screening coverage

**Table 5. Cancer incidence rates for three populations in their countries of origin (source: GLOBOCAN 2002), the same population in Florida, and non-Hispanic Whites in Florida. Selected cancers, 1999 to 2001**

| | Mexican Hispanics | | NH Whites in Florida | Puerto Ricans | | NH Whites in Florida | Cuban Hispanics | | NH Whites in Florida |
|---|---|---|---|---|---|---|---|---|---|
| | Country of origin, Mexico | In Florida | | Country of origin, Puerto Rico | In Florida | | Country of origin, Cuba | In Florida | |
| Males | | | | | | | | | |
| All cancers | 144.5 | 237.9 | 402.0 | 264.3 | 367.0 | 402.0 | 166.5 | 363.6 | 402.0 |
| Prostate | 29.9 | 57.2 | 108.9 | 100.1 | 103.3 | 108.9 | 28.2 | 107.0 | 108.9 |
| Colon and rectum | 7.9 | 21.8 | 42.5 | 26.6 | 46.9 | 42.5 | 13.4 | 44.2 | 42.5 |
| Lung | 17.0 | 36.2 | 67.4 | 19.5 | 45.8 | 67.4 | 40.0 | 52.8 | 67.4 |
| Bladder | 5.6 | 9.5 | 17.8 | 9.3 | 10.8 | 17.8 | 7.7 | 19.1 | 17.8 |
| Stomach | 13.1 | 8.6 | 5.6 | 14.2 | 11.8 | 5.6 | 7.1 | 6.0 | 5.6 |
| Liver | 5.0 | 6.6 | 4.8 | 5.6 | 13.8 | 4.8 | 4.3 | 6.4 | 4.8 |
| Females | | | | | | | | | |
| All cancers | 150.0 | 217.4 | 320.7 | 162.8 | 275.6 | 320.7 | 151.0 | 262.6 | 320.7 |
| Breast | 26.4 | 50.5 | 101.4 | 50.4 | 82.3 | 101.4 | 31.2 | 77.9 | 101.4 |
| Colon and rectum | 7.0 | 18.7 | 29.6 | 20.5 | 29.8 | 29.6 | 17.0 | 39.1 | 29.6 |
| Lung | 6.7 | 25.1 | 46.7 | 6.6 | 25.1 | 46.7 | 16.3 | 19.9 | 46.7 |
| Endometrium | 4.2 | 11.4 | 15.4 | 9.1 | 15.5 | 15.4 | 7.6 | 15.8 | 15.4 |
| Stomach | 9.5 | 2.7 | 2.3 | 6.3 | 5.3 | 2.3 | 4.3 | 2.9 | 2.3 |
| Liver | 4.9 | 3.3 | 1.6 | 2.6 | 2.4 | 1.6 | 3.9 | 2.9 | 1.6 |
| Cervix | 29.5 | 13.8 | 8.4 | 8.8 | 12.5 | 8.4 | 20.2 | 8.4 | 8.4 |

NOTE: All rates are average annual per 100,000 age adjusted to the World Standard Population.

in Cuba is reported to be very high, reaching nearly 80% of women at least once in their lives (26). Accordingly, no differences in rates between U.S. Cubans and Cuban women on the island were observed. Among Puerto Ricans, however, the rate of cervical cancer was higher in Florida, an intriguing pattern given that screening rates tend to be higher in mainland United States (27).

The observed patterns between Puerto Rico and Puerto Ricans in Florida (increases for most cancers, including liver in males and cervix in females, and decreases in stomach cancer in both sexes and liver in females) were similar to those found two decades earlier comparing rates in Puerto Rico to Hispanics in New York City, who, in the 1980s, were mostly Puerto Rican (4). This finding in two different parts of the United States suggests consistent patterns of changes in cancer risk among Puerto Ricans who move to the mainland.

Several limitations of this study include possible misclassification of ethnicity in registry records or death certificates. The estimates for Mexicans were based on low numbers and are hence unstable. In addition, the Florida Registry does not receive cancer reports from the Department of Veteran Affairs facilities. The impact of these missing cases on cancer rates for Hispanics has not been studied. In addition, Hispanics in Florida are not necessarily representative of the full spectrum of the populations in their countries of origin in socioeconomic status or race. Race or socioeconomic status may therefore distort some comparisons between countries of origin and Hispanic subpopulations in Florida. The most striking example is that Cuban Americans in Florida are overwhelmingly White, whereas most islanders are either Mulatto or Black (28). Finally, cancer registry efforts are variable depending on country. This is particularly true in Mexico, where the absence of a long-standing cancer registry may hamper comparisons. Puerto Rico and Cuba have established active registries with data quality meeting publication criteria for Volume VIII of Cancer Incidence in Five Continents of the IARC. The IARC GLOBOCAN estimates are nevertheless the best contemporary information on international patterns of cancer incidence (29).

Acculturation and assimilation from Latin-American culture into the Anglo-American mainstream culture has been "positively" related to some risk factors for cancer [smoking (19, 30), alcohol intake (19, 31), obesity (32)] but also with beneficial factors such as exercise (33). However, this process is not uniform across race, ethnicity, or subpopulation (34), and is related to length of time spent in the United States (30). Future study on cancer patterns among Florida Hispanics should consider the role of acculturation and the length of time in the United States, especially because Mexicans and New Latinos are more recent arrivals to Florida.

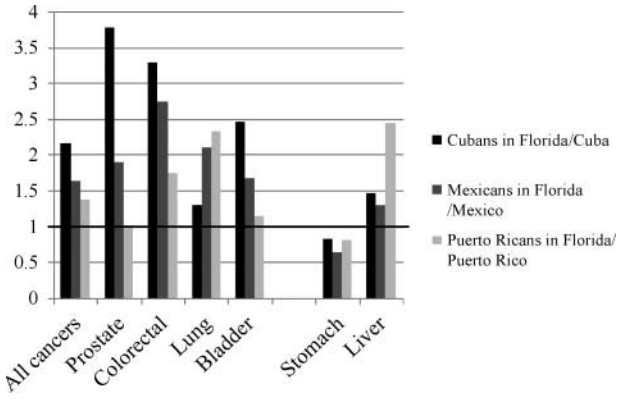


**Figure 1.** Standardized incidence rate ratios for Hispanic males (Cubans, Mexicans, and Puerto Ricans) between Florida (1999-2001) and their respective countries of origin; selected cancers.

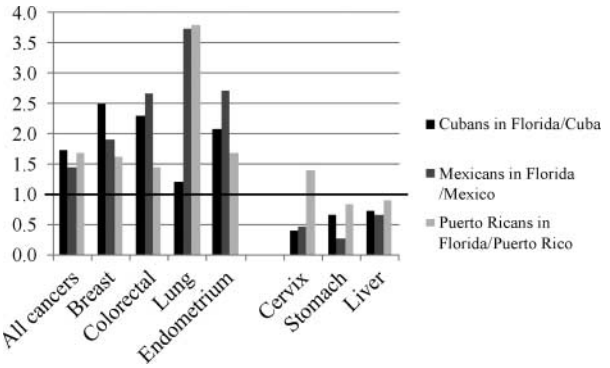


**Figure 2.** Standardized incidence rate ratios for Hispanic females (Cubans, Mexicans, and Puerto Ricans) between Florida (1999-2001) and their respective countries of origin; selected cancers.

The strength of this study arises from the separate analysis of each Hispanic subpopulation and the unique characteristics of Florida Hispanics (cancer population being mostly foreign born). Consequently, differences in incidence rather than merely mortality could be analyzed between Hispanic populations in their countries of origin, those of the same Hispanic populations who moved to the United States, and the U.S. non-Hispanic population.

In conclusion, knowledge of cancer patterns in these subpopulations is vital. These data influence public health policy and form the basis of etiologic hypotheses. This study shows that each Hispanic subpopulation has a distinct cancer profile. Puerto Ricans are the most affected by cancer and Mexicans the least. The advantage that Hispanics have over Whites in several health outcomes (18) seems limited, in cancer incidence, to Mexicans. Finally, the higher risk for cancer observed among Hispanics who move to the United States should be further investigated.

## Disclosure of Potential Conflicts of Interest

No potential conflicts of interest to disclose.

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