

RACIAL AND ETHNIC DISPARITIES IN LIFETIME RISK OF CORPUS UTERINE CANCER: A COMPARATIVE STUDY OF PUERTO RICO AND THE UNITED STATES SEER POPULATION

Background: Corpus uterine cancer is the most common gynecologic malignancy in Puerto Rico and the United States.

Methods: We assessed the lifetime risk of developing and dying of corpus uterine cancer in women living in Puerto Rico (PR) and among Hispanics, non-Hispanic Whites (NHW), and non-Hispanic Blacks (NHB) in the United States. Data from the PR Central Cancer Registry and the Surveillance, Epidemiology, and End Results program were analyzed from 1993-2004.

Results: In PR, the probability of developing corpus uterine cancer increased from 1.21% in 1993-1995 to 1.69% in 2002-2004. The probability of developing this malignancy from 2002-2004 was 1.59% for NHB, 1.80% for Hispanics and 2.54% for NHW. The ratio of estimated probabilities only showed significant lower risk in PR as compared to NHW (.67, 95% CI=.59-.74). The probability of dying from corpus uterine cancer during 2002-2004 was .47% for Hispanics, .49% for NHW, .53% for PR and .76% for NHB. The ratio of estimated probabilities only showed significant lower risk of death in PR as compared to NHB (.70, 95% CI=.54-.85).

Conclusions: The lifetime risk of developing corpus uterine cancer has increased in PR, suggesting higher exposure to risk factors in this population. Despite the lower lifetime risk of this malignancy in PR as compared to NHW, the similar lifetime risk of death in these groups suggests a disparity that may be influenced by differences in disease etiology and/or access or response to treatment. Assessment of risk

From Department of Biostatistics and Epidemiology, Graduate School of Public Health, Medical Sciences Campus, University of Puerto Rico, San Juan (APO, SG, OG, KS, ES, YO) and Cancer Control and Population Sciences Program, University of Puerto Rico Comprehensive Cancer Center, San Juan (APO) and Gynecology Oncology Program, Department of Obstetrics and Gynecology, School of Medicine, Medical Sciences Campus, University of Puerto Rico, San Juan (SU) and Puerto Rico Central Cancer Registry, Cancer Control and Population Sciences Program, University of Puerto Rico Comprehensive Cancer Center, San Juan (NF, KJO).

Ana Patricia Ortiz, PhD; Yomayra Otero, MS; Katherine Svensson, MS; Omar García-Rodríguez, MS; Sheyla Garced, MS; Elvis Santiago, BS; Sharee Umpierre, MD; Nayda Figueroa, MD, MPH; Karen J. Ortiz-Ortiz, MA, MPH

factors, in addition to access to health services, is required to further understand these patterns. (*Ethn Dis.* 2012;22(1):90-95)

Key Words: Endometrial Cancer, Hispanics, Minority Health, Health Status Disparities, Risk

INTRODUCTION

Corpus uterine cancer is the fourth in incidence, and the sixth leading cause of cancer mortality among women in the United States.¹ In Puerto Rico, this cancer is the 3rd most common, the 9th most common cause of cancer death, and the most common gynecologic malignancy, with incidence rates of 15.3 per 100,000 from 2000-2004.² In 2004, the total productivity losses in the labor market due to this malignancy in Puerto Rican residents were close to 1 million dollars, being the 10th most costly cancer among women.³ Literature on ethnic differences of cancers of the uterine corpus in the United States has focused mainly on non-Hispanic Blacks (NHB) and non-Hispanic Whites (NHW), with fewer comparisons with other ethnic groups.⁴

Although according to the US Census, 99% of persons in Puerto Rico are of Hispanic origin,⁵ cancer data from

Puerto Rico (a US territory) are not included in the US cancer statistics.⁶ Recent data suggests that incidence and mortality of cancer of the uterine corpus, and specifically of the endometrium, are lower among Hispanics⁷ in the United States and Puerto Ricans⁸ than among NHW in the United States, supporting the evidence of racial and ethnic disparities in the occurrence of this gynecologic malignancy. Racial/ethnic differences in disease incidence suggest the presence of protective factors or lower exposure to risk factors for corpus uterine cancer in PR, as well as potential histological differences in disease profile.

The lifetime risk of developing and dying from cancer are statistics commonly used to communicate risk estimates to the population.⁹ The lifetime and age-conditional risk provide an estimate of the proportion of the population expected to develop the disease. Lifetime risk refers to the proportion of the infant population expected to develop a disease over the average lifespan in a population; whereas, the age-conditional risk refers to the proportion of people expected to be diagnosed with a disease within a specified time period, among those free of the disease at a given age.¹⁰ Based on rates from 2004-2006, 2.53% women born today in the United States (1 in 40) will be diagnosed with cancer of the corpus and uterus, not otherwise specified at some time during their lifetime;¹¹ however, this risk has never been estimated in Puerto Rican women. Given the limited availability of data on

Address correspondence to Ana Patricia Ortiz, PhD; Cancer Control and Population Sciences Program; University of Puerto Rico Comprehensive Cancer Center; PMB 711, Ave de Diego 89, Suite 105; San Juan, PR 00927-6346; 787.772.8300 x1204; 787.764.5831 (fax); ana.ortiz7@upr.edu

We evaluated the lifetime risk of developing and dying of corpus uterine cancer, as well as the age-conditional probabilities of the disease for the 1993–2004 period in Puerto Ricans.

interethnic differences on the occurrence of uterine corpus cancer and to further our understanding on the burden of this malignancy in Puerto Ricans and how it compares with other racial/ethnic groups in the United States, we evaluated the lifetime risk of developing and dying of corpus uterine cancer, as well as the age-conditional probabilities of the disease for the 1993–2004 period in Puerto Ricans. These estimates were also compared with data for Hispanics, NHW and NHB in the US SEER population.

METHODS

Data Sources

Incident cases data for corpus uterine cancer were obtained from the Puerto Rico Central Cancer Registry (PRCCR) for 1993–2004.¹² The PRCCR uses the Surveillance, Epidemiology, and End Results (SEER) Program and the North American Association of Central Cancer Registries (NAACCR) standards for data coding, thus, the registry is comparable with SEER data. Mid-year population statistics were obtained from the PRCCR as reported by the Census Office, Puerto Rico Planning Board. Mortality data for Puerto Ricans were also obtained from the PRCCR (which collects data from death certificates enacted by the Puerto Rico Health Department).¹³ Corpus uterine cancer incidence data for the US (NHW, NHB, and Hispanics) from 1993–2004 were obtained from the

SEER 13 database, the national cancer surveillance system of the United States.¹⁴ Mid-year population data were obtained from the SEER 13 database as reported by the US Census Bureau. US mortality data were obtained from the National Center for Health Statistics available on the SEER*Stat database.¹⁵ These data include mortality data for the entire US population (excluding Puerto Rico).

We included women diagnosed with cancer of the corpus uteri and other uterus not otherwise specified (ICD-O-3 C54.0–54.9 and 55.9), with histological codes from 8000–8576; most of the cases (85.7%) comprised cancer of the endometrium (C54.1). The analysis was limited to primary cases of malignant cancer, with known diagnosis confirmation (96.0% confirmed microscopically), or those diagnosed by death certificates only (3.6%). All cancer cases were classified according to the International Classification of Disease for Oncology (ICD-O-3)¹⁶ and cancer deaths were classified according to the International Classification of Diseases (ICD-10).¹⁷

Statistical Analysis

The risk of developing and dying from corpus uterine cancer were calculated using age-specific incidence, uterine cancer related mortality, and all-cause mortality rates (excluding this carcinoma) of each racial/ethnic group, for 2002–2004. Incidence rates of corpus uterine cancer only considered the first occurrence of the disease for each woman. In order to calculate the lifetime probabilities, standard multiple-decrement life tables were constructed starting from birth for a hypothetical cohort of 10,000,000 women in Puerto Rico and for each racial/ethnic group in the United States. In this model, each woman was subjected to two mutually exclusive events: 1) being diagnosed with corpus uterine cancer or 2) death from other diseases without developing corpus uterine cancer. Probabilities derived from the calculated age-specific incidence and mortality rates were applied

to the hypothetic cohort to yield the number of women expected to develop or die from corpus uterine cancer, and the number of women expected to die from other causes without having developed or died from this malignancy within each ten-year interval (from 0 to 40 and then every ten years until an open interval of ≥ 85 years).

In order to assess significant differences in the lifetime risk of developing and dying from endometrial cancer, between Puerto Ricans and the other racial/ethnic sub-groups, we also calculated the ratio of the estimated probabilities (RP) and their corresponding 95% confidence intervals. The age-conditional probability of developing and dying of corpus uterine cancer was also calculated for the studied US racial/ethnic groups (NHW, NHB and Hispanics) and Puerto Ricans. Trends of the lifetime probability of developing cancer of the corpus and uterus for Puerto Rican and US groups were calculated for each of following three-year calendar periods: 1993–1995, 1996–1998, 1999–2001 and 2002–2004. The incidence/mortality ratio for each racial/ethnic group was calculated based on 2002–2004 lifetime risk estimates.

In order to determine the effect of decreases in overall women mortality, we also calculated the estimates for each period using the observed rates of corpus uterine cancer incidence in all study periods, while holding mortality due to other causes constant at its 1993–1995 levels, following suggested methodologies in lifetime risk calculations.^{9,18} We applied the Feuer et al⁹ and Fay et al¹⁹ methods to appropriate data sets. All statistics were calculated using the Probability of Developing Cancer software program (DEVCAN 6.5).²⁰

RESULTS

The risk of developing corpus uterine cancer among women for the 2002–2004 period was 1.59% for NHB, 1.69% for Puerto Ricans, 1.80% for Hispanics and

Table 1. Risk of developing and dying from cancer of the corpus and uterus, not otherwise specified before a specified age (Z), conditioned to be free of this cancer at current age (Y) in Puerto Rico and the United States, by ethnic groups (2002–2004).

Current age (Y), years						Probability by age (Z), %				Incidence-Mortality ratio
	40	50	60	70	80	Developing eventually % (95% CI)	One in:	Dying eventually % (95% CI)	One in:	
Puerto Rico										
0	.10	.22	.54	1.01	1.40	1.69 (1.58–1.81)	59	.53 (.46–.61)	189	3.19
40		.13	.45	.94	1.35	1.65 (1.53–1.77)	61	.54 (.47–.62)	185	3.06
50			.33	.83	1.24	1.55 (1.44–1.67)	65	.52 (.45–.60)	192	2.98
60				.52	.95	1.27 (1.17–1.39)	79	.49 (.42–.57)	204	2.59
70					.48	.84 (.74–.95)	119	.44 (.36–.52)	227	1.91
80						.47 (.38–.57)	213	.35 (.27–.45)	286	1.34
US NHB										
0	.05	.14	.42	1.00	1.36	1.59 (1.48–1.70)	63	.76 (.73–.79)	131	2.09
40		.10	.39	1.01	1.38	1.62 (1.51–1.74)	62	.80 (.77–.830)	125	2.03
50			.31	.95	1.34	1.59 (1.48–1.71)	63	.81 (.78–.84)	123	1.96
60				.70	1.13	1.41 (1.29–1.53)	71	.80 (.77–.83)	125	1.76
70					.52	.84 (.74–.95)	119	.64 (.61–.67)	156	1.31
80						.48 (.39–.60)	208	.42 (.39–.46)	238	1.14
US NHW										
0	.05	.21	.75	1.52	2.14	2.54 (2.49–2.59)	39	.49 (.49–.50)	202	5.18
40		.16	.72	1.51	2.16	2.56 (2.51–2.61)	39	.50 (.50–.51)	200	5.12
50			.57	1.38	2.04	2.45 (2.40–2.50)	41	.50 (.49–.51)	200	4.90
60				.85	1.55	1.98 (1.93–2.03)	51	.47 (.46–.48)	213	4.21
70					.78	1.28 (1.24–1.32)	78	.40 (.39–.41)	250	3.20
80						.67 (.64–.71)	149	.29 (.28–.30)	345	2.31
US Hispanics										
0	.07	.21	.57	1.06	1.45	1.80 (1.67–1.93)	56	.47 (.43–.50)	215	3.83
40		.14	.52	1.02	1.42	1.77 (1.65–1.91)	56	.47 (.44–.51)	215	3.02
50			.38	.89	1.30	1.66 (1.53–1.80)	60	.47 (.43–.51)	215	3.53
60				.53	.95	1.33 (1.20–1.46)	75	.44 (.40–.48)	227	3.02
70					.46	.87 (.76–1.06)	114	.37 (.33–.41)	270	2.35
80						.52 (.40–.66)	192	.29 (.24–.33)	345	1.79

NHB, non-Hispanic Blacks; NHW, non-Hispanic Whites; US, United States

2.54% for NHW (Table 1). The risk of developing this malignancy among women in Puerto Rico during this period was 33% lower (RP: .67; 95% CI=.59–.74) than for NHW ($P<.05$), although when Puerto Ricans were compared with Hispanics (RP: .94, 95% CI=.84–1.04) and NHB (RP: 1.06, 95% CI=.96–1.16) no significant differences were observed ($P>.05$) (data not shown). Meanwhile, the probability of dying from corpus uterine cancer during 2002–2004 was 0.47% for Hispanics, .49% for NHW, .53% for Puerto Ricans and .76% for NHB (Table 1). The probability of death from this malignancy in Puerto Ricans during this period was 30% lower than for NHB (RP=.70, 95% CI=.54–0.85), although when Puerto Ricans were compared with

Hispanics (RP: 1.13, 95% CI=.96–1.29) and NHW (RP: 1.09, 95% CI=.93–1.23) no significant differences were observed ($P>.05$) (data not shown).

Age-conditional probabilities indicate that 40-year-old women in Puerto Rico currently free of corpus uterine cancer have a 1.65% risk of developing this cancer eventually and a .54% risk of eventually dying from this cancer (Table 1). Additional analysis of the lifetime risk estimates of developing and dying from corpus uterine cancer during 2002–2004 showed a higher ratio of cases die in Puerto Rico (1 in 3) compared with NHW (1 in 5) in the United States. Incidence-mortality ratio for Puerto Ricans was higher than Hispanics (1 in 4), but lower than NHB (1 in 2) (Table 1).

When we compare the estimates by time periods, the lifetime risk of corpus uterine cancer in Puerto Ricans increased from 1.21% in the 1993–1995 period to 1.69% in the 2000–2004 period (Figure 1). A similar increase in lifetime risk was also observed for NHB, for whom the lifetime risk increased from 1.26% during 1993–1995 to 1.59% during 2002–2004. Among US Hispanics, the lifetime risk fluctuated from 1.72% to 1.80%. In contrast, lifetime risk estimates for NHW decreased from 2.71% to 2.54% during the study period.

As expected, sensitivity analysis holding mortality rates constant over the study period produced lower overall risk estimates among Puerto Rican women (1.57% [1 in 64]) in 2002–2004 in comparison with the observed

DISCUSSION

Our study is the first to compare lifetime risk estimates of corpus uterine cancer in Puerto Ricans as compared to other racial/ethnic groups in the United States, contributing to our understanding of racial/ethnic disparities in the occurrence of this gynecologic malignancy. Our results showed that women in Puerto Rico had lower lifetime risk of developing corpus uterine cancer during 2002–2004, as compared to NHW, although similar risk as NHB and Hispanics. However, the lifetime risk of dying for Puerto Ricans was lower than NHB, and similar to Hispanics and NHW. Our estimates of risk are consistent to those reported in previous studies.⁸ For example, the lower lifetime risk of this malignancy among women in Puerto Rico is consistent with studies that demonstrate a lower burden of the disease in this population as compared to the United States.^{8,21–23} Although the reasons are uncertain, potential explanations for the lower lifetime risk of uterine cancer in Puerto Ricans compared to NHW in the United States could be explained by differences in behavioral and genetic factors or gene-environment interactions in these populations, which might protect women in Puerto Rico from uterine cancer development. For example, genetic admixture of Puerto Ricans could provide them with lower genetic susceptibility to the disease,^{24,25} and epigenetic differences between these groups could exist, as have been documented between NHW and NHB.⁴

Increases in the lifetime risk of this malignancy in Puerto Ricans over time may also be due to increased presence of risk factors in this population. Puerto Ricans and Hispanics in the United States have acquired Western habits that mirror those of industrialized nations,⁸ which might be responsible for the increasing risk of certain cancers. These changing lifestyles include sedentary lifestyle, dietary habits, higher obesity rates, declines in parity, and a younger

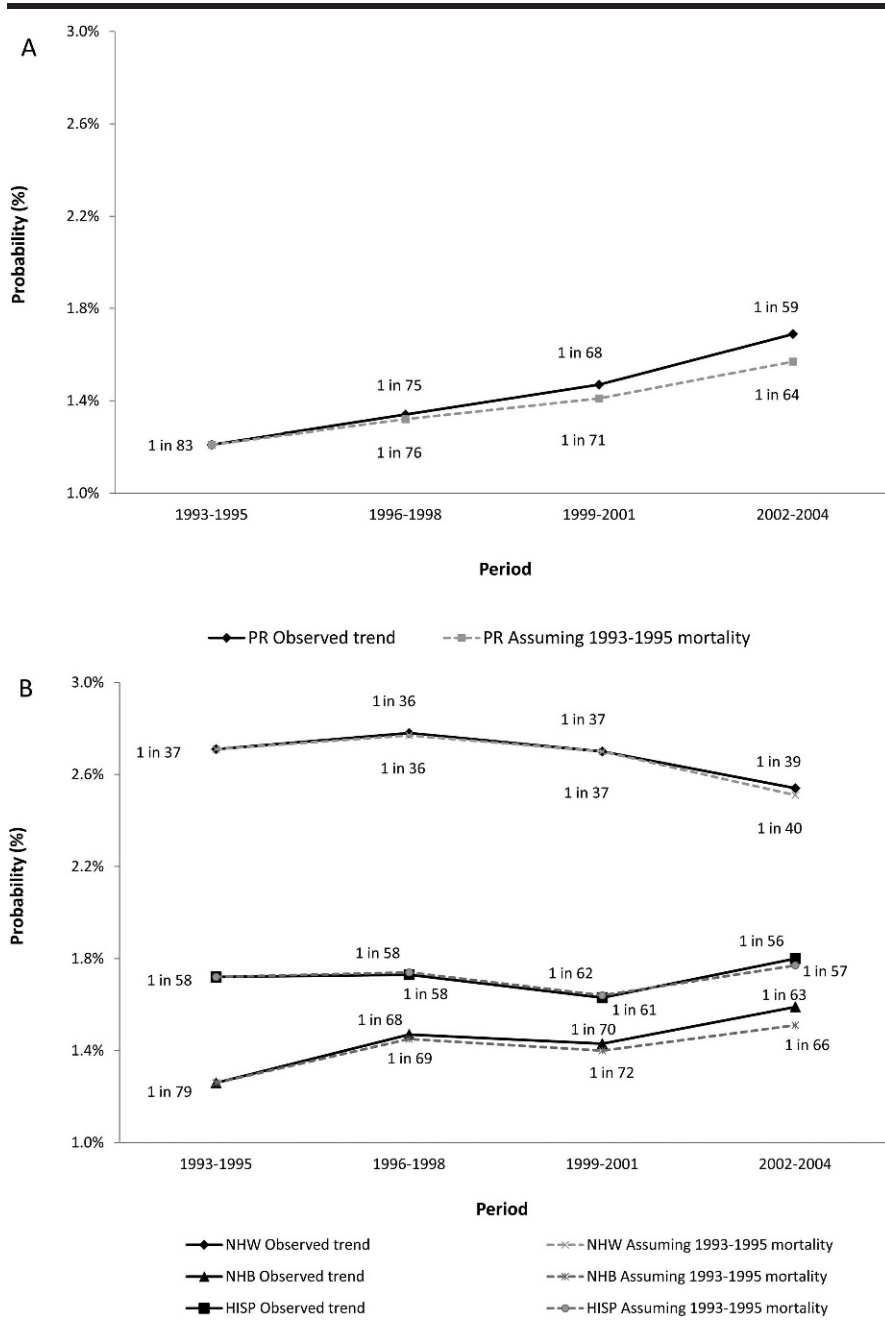


Figure 1. Lifetime probability of developing cancer of the corpus and uterus, not otherwise specified for women living in Puerto Rico and the United States, by ethnic group (1993–2004).

estimates (1.69% [1 in 59]), showing a small effect on the lifetime risk of developing corpus uterine cancer. Assuming independence between corpus uterine cancer incidence and mortality due to other causes, the increase of .48 new corpus uterine cancer per 100 women born (from 1.21% to 1.69%)

is explained by two factors: 25.0% of the new cases are attributable to an increase in longevity for women during the periods ($[(.0169-.0157)/.0048 = 25\%]$ and 75.0% of the new cases are attributable to the increase in corpus uterine cancer incidence over that time ($[(.0157-.0121)/.0048 = 75.0\%]$).

Our results showed that women in Puerto Rico had lower lifetime risk of developing corpus uterine cancer during 2002–2004, as compared to NHW, although similar risk as NHB and Hispanics.

age at menarche.^{8,26} Meanwhile, the use of oral contraceptives is not as common among women in Puerto Rico (18.5%) when compared to the United States (30%),²⁷ while during the last decades there has been a decrease in parity which is now more similar to the United States (2 children per woman).²⁸ Therefore, these factors cannot solely explain the lower risk for uterine cancer among Puerto Rican women. Related to metabolic risk factors, obesity and diabetes, two of the major risk factors associated with uterine cancer^{29,30} have increased among Puerto Rican women in the last decade.³¹ Also, although the prevalence of obesity in Puerto Rico is comparable to that in the United States, the prevalence of diabetes is the highest of all states in, and territories of, the United States.³² Furthermore, the prevalence of metabolic syndrome, another proposed risk factor for endometrial cancer, closely related to diabetes and obesity, is also high among women in Puerto Rico.³³ Consequently, the high prevalence of these metabolic risk factors among women in this population is of concern, as they may further increase the lifetime risk of uterine cancer.

Despite the lower lifetime risk of developing uterine cancer in Puerto Rico, our study showed that although Puerto Ricans had a lower cumulative risk than NHW, they had a similar cumulative risk of dying of the disease. Also, we observed that a higher ratio of cases die in Puerto Rico (1 in 3) and among NHB (1 in 2) compared with NHW (1 in 5) and

Hispanics (1 in 4) in the United States. These findings suggest health disparities between women in Puerto Rico and NHW, similar to those observed among NHB. Our results are consistent to the previously documented, for 1992–2002, higher lifetime risk of death among NHB as compared to NHW¹¹ and to the lower 5-year survival documented for women in Puerto Rico (63%) and NHB (57%) as compared to NHW (78%) and Hispanic (80%) women in the United States.⁸ As has been documented with the case of racial disparities between NHW and NHB women,⁴ poorer prognosis of women in Puerto Rico as compared to NHW women could be potentially explained by multiple factors, including later diagnosis, treatment disparities, comorbid conditions and differences in the histological aggressiveness and genetics of tumor subtypes. Further research in this area is warranted to understand if, similar to NHB, these reasons explain this disparity for women in Puerto Rico. Similar to other Hispanic subgroups, Puerto Ricans are an admixed population,³⁴ thus, the higher mortality risk in Puerto Ricans (similar to NHB) could be influenced by the heterogeneous genetic ancestral background, specifically the West African influence.³⁵ In addition to possible health disparities in access to early detection, education and adequate treatment, differences could be explained by variations in pharmacogenomics and response to treatment among Puerto Ricans. Given the high poverty level in Puerto Rico,⁵ and the association between low socioeconomic status and reduced cancer survival,³⁶ sociodemographic risk factors should also be considered in these studies. Also, sensitivity analysis allows us to confirm that besides higher life expectancy, risk factors that may be related to lifestyles influence the lifetime risk of uterine cancer in woman in Puerto Rico.

A limitation of this study is the lack of adjustment by hysterectomy rates in Puerto Rico and the United States; the prevalence of hysterectomy for adult women is high (>20%).^{32,37} Women

with hysterectomy are not at risk for the disease and their inclusion in the calculation of population-based cancer rates artificially lowers estimates of disease occurrence.¹⁰ In a study in the United States, the lifetime probability of developing uterine cancer was 2.6%, but ranged from 4.2%–4.6% when corrected by hysterectomy.³⁷ Also, given that lifetime risk estimates are based on the general population, certain population sub-groups, such as people with certain environmental exposures or hereditary diseases that predispose them to cancer may be at even greater lifetime risk of the disease. Consequently, our findings apply to the average individual, and not those with increased disease risk.

Our study expands the knowledge of uterine cancer in Puerto Rico and serves as a baseline for the development of future uterine cancer research, prevention and control strategies in this population. Modifiable and non-modifiable risk factors should be considered in future analyses, as well as potential gene-environment interactions in order to better understand what factors influence uterine cancer risk in Puerto Rico and the increases in lifetime risk documented by our study. Interventions should focus on known disease risk factors in this population, and on securing access to state-of-the-art treatments, in order to have an impact on corpus uterine cancer prevention and control.

ACKNOWLEDGMENTS

We acknowledge the statistical consultation provided by Dr. Erick Suarez, Biostatistics and Bioinformatics Core of the U54 grant, from the UPR/MDACC Partnership for Excellence in Cancer Research (NIH NCI U54CA96300) in the review of this manuscript. Research infrastructure was partially funded by the following grants of the National Institutes of Health (NIH): G12RR03051, U54CA96297, U54CA96300 and 5P20RR0-11126 and by an unrestricted educational grant from Bristol-Myers Squibb, PR. Study contents are solely the responsibility of the authors and do not necessarily represent the official view of the NIH.

REFERENCES

1. Jemal A, Siegel R, Ward E, et al. Cancer statistics, 2008. *CA Cancer J Clin.* 2008;58(2):71–96.

2. Torres-Cintrón M, Ortiz AP, Pérez-Irizarry J, et al. Incidence and mortality of the leading cancer types in Puerto Rico: 1987–2004. *PR Health Sci J*. 2010;29(3):317–329.
3. Ortiz-Ortiz KJ, Pérez-Irizarry J, Marín-Centeno H, et al. Productivity loss in Puerto Rico's labor market due to cancer mortality. *PR Health Sci J*. 2010;29(3):241–249.
4. Allard JE, Maxwell GL. Race disparities between Black and White women in the incidence, treatment, and prognosis of endometrial cancer. *Cancer Control*. 2009;16(1):53–56.
5. US Census Bureau. US Census Bureau, 2005–2009: American Community Survey 5-year estimates. 2009. http://factfinder.census.gov/servlet/DTTable?_bm=y&-geo_id=04000US72&-ds_name=ACS_2009_5YR_G00_&-redoLog=false&-mt_name=ACS_2009_5YR_G2000_B03001. Accessed September 9, 2011.
6. American Cancer Society. *Cancer Facts & Figures*. Atlanta, Ga: American Cancer Society; 2008.
7. Setiawan VW, Pike MC, Kolonel LN, Nomura AM, Goodman MT, Henderson BE. Racial/ethnic differences in endometrial cancer risk: the multiethnic cohort study. *Am J Epidemiol*. 2007;165:262–270.
8. Ortiz AP, Perez J, Otero-Dominguez Y, et al. Endometrial cancer in Puerto Rico: incidence, mortality and survival (1992–2003). *BMC Cancer*. 2010;10(1):31.
9. Feuer EJ, Wun LM, Boring CC, Flanders WD, Timmel MJ, Tong T. The lifetime risk of developing breast cancer. *J Natl Cancer Inst*. 1993;85:848–849.
10. Merrill R, Lyon J, Wiggins C. Comparison of two methods based on cross-sectional data for correcting corpus uterine cancer incidence and probabilities. *BMC Cancer*. 2001;1:13.
11. Horner MJ, Ries L, Krapcho M, et al. SEER Cancer Statistics Review, 1975–2006. http://seer.cancer.gov/csr/1975_2006/. Accessed September 9, 2011.
12. Puerto Rico Central Cancer Registry: Puerto Rico Cancer Incidence File. Comprehensive Cancer Center: Central Cancer Registry, released April 2010.
13. Puerto Rico Central Cancer Registry: Puerto Rico Mortality File. Provided by the Division of Statistical Analysis, Auxiliary Secretariat for Planning and Development Puerto Rico Department of Health, 2006.
14. Surveillance, Epidemiology, and End Results (SEER) Program www.seer.cancer.gov SEER* Stat Database: Incidence-SEER 13 Regs Research Data, Nov 2008 Sub (1992–2006) <Katrina/Rita Population Adjustment> -Linked To County Attributes-Total US., 1969–2006 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2009, based on the November 2008 submission. <http://www.cdc.gov/nchs>.
15. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Mortality-All COD, Aggregated With State, Total U.S. (1990–2006) <Katrina/Rita Population Adjustment>, National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released May 2009. Underlying mortality data provided by NCHS. <http://www.cdc.gov/nchs>.
16. Fritz A, Jack A, Percy C, Parkin M, Sobin L, eds. *International Classification of Diseases for Oncology*. 3rd ed. Geneva: World Health Organization; 2000.
17. World Health Organization. *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death*. Geneva: World Health Organization; 1990, Vol-1, 10th revision.
18. Leung GM, Thach TQ, Chang E, et al. Short-term, medium-term, long-term, and lifetime risks of developing and dying of breast carcinoma in the westernized Chinese population. *Cancer*. 2005;103(3):501–508.
19. Fay MP. Estimating age conditional probability of developing disease from surveillance data; *Population Health Metrics*. 2004;2:6. <http://www.pophealthmetrics.com/content/2/1/6>. Accessed February 14, 2011.
20. National Cancer Institute. *DevCan: Probability of Developing or Dying of Cancer*. version 6.5.0. <http://srab.cancer.gov/devcan>. Accessed September 9, 2011.
21. Martínez I, Torres-Llauger R. Experiencia con el Registro de Cáncer de Puerto Rico. *Bol Asoc Med PR*. 1991;83(6):258–260.
22. Poldnak AP. Cancer incidence in the Puerto Rican-born population of Long Island, New York. *Am J Public Health*. 1991;81(11):1405–1407.
23. Ho GY, Figueroa-Vallés NR, De La Torre-Feliciano T, et al. Cancer disparities between mainland and island Puerto Ricans. *Rev Panam Salud Publica*. 2009;25(5):394–400.
24. Tang H, Choudhry S, Mei R, et al. Recent genetic selection in the ancestral admixture of Puerto Ricans. *Am J Hum Genet*. 2007;81:626–633.
25. Hanis CL, Hewett-Emmett D, Bertin TK, Schull WJ. Origins of US Hispanics. Implications for diabetes. *Diabetes Care*. 1991;14:618–627.
26. Torres-Cintrón M, Ortiz AP, Pérez-Irizarry J, et al. Incidence and mortality of the leading cancer types in Puerto Rico: 1987–2004. *PR Health Sci J*. 2010;29(3):317–329.
27. Bensyl DM, Iuliano DA, Carter M, Santelli J, Gilbert BC. Contraceptive use-United States and territories, Behavioral Risk Factor Surveillance System. *MMWR Surveill Summ*. 2005;54(6):1–72.
28. US Census Bureau. Table A-9. Total fertility rate by region and country: 1990–2050. <http://www.census.gov/ipc/prod/wp02/tabA-09.pdf>. Accessed February 16, 2011.
29. Saltzman BS, Doherty JA, Hill DA, et al. Diabetes and endometrial cancer: an evaluation of the modifying effects of other known risk factors. *Am J Epidemiol*. 2008;167(5):607–614.
30. Charneco E, Ortiz AP, Venegas-Ríos HL, Romaguera J, Umpierre S. Clinic-based case-control study of the association between body mass index and endometrial cancer in Puerto Rican women. *PR Health Sci J*. 2010;29(3):272–278.
31. Chowdhury PP, Balluz L, Murphy W, et al. Surveillance of certain health behaviors among states and selected local areas—United States, 2005. *MMWR Surveill Summ*. 2007;56(4):1–160.
32. Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey Data*. Atlanta, Ga: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2008.
33. Pérez CM, Guzmán M, Ortiz AP, et al. Prevalence of the metabolic syndrome in San Juan, Puerto Rico. *Ethn Dis*. 2008;18(4):434–441.
34. Tang H, Choudhry S, Mei R, et al. Recent genetic selection in the ancestral admixture of Puerto Ricans. *Am J Hum Genet*. 2007;81:626–633.
35. Hanis CL, Hewett-Emmett D, Bertin TK, Schull WJ. Origins of US Hispanics. Implications for diabetes. *Diabetes Care*. 1991;14:618–627.
36. Howlander N, Ries LA, Mariotto AB, Reichman ME, Ruhl J, Cronin KA. Improved estimates of cancer-specific survival rates from population-based data. *J Natl Cancer Inst*. 2010;102(20):1584–1598.
37. Saraiya M, Lee NC, Blackman D, Smith MJ, Morrow B, McKenna MA. Self-reported Papanicolaou smears and hysterectomies among women in the United States. *Obstet Gynecol*. 2001;98(2):269–278.

AUTHOR CONTRIBUTIONS

Study design: Ortiz, Otero, Svensson, García-Rodríguez, Garced, Santiago, Umpierre, Figueroa, Ortiz-Ortiz

Acquisition of data: Figueroa, Ortiz-Ortiz

Data analysis and interpretation: Ortiz, Otero, Svensson, García-Rodríguez, Garced, Santiago, Umpierre, Figueroa, Ortiz-Ortiz

Manuscript draft: Ortiz, Otero, Svensson, García-Rodríguez, Garced, Santiago, Umpierre, Ortiz-Ortiz

Statistical expertise: Ortiz, Otero, Svensson, García-Rodríguez, Garced, Santiago, Ortiz-Ortiz

Acquisition of funding: Figueroa, Ortiz

Administrative: Ortiz, Umpierre, Figueroa,

Supervision: Ortiz, Umpierre, Figueroa