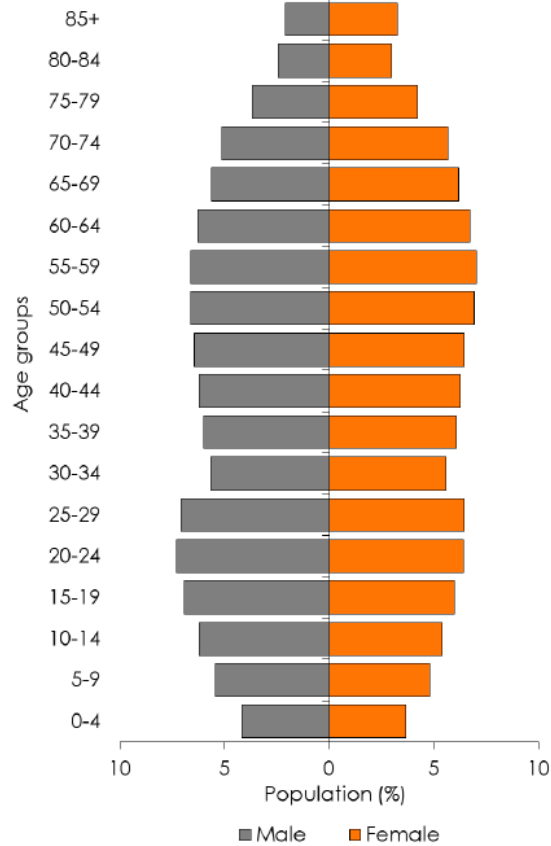# Cancer Demographics in Puerto Rico

Marcia Cruz-Correa, MD, PhD, FAAAS, AGAF, FASGE

Professor of Medicine & Biochemistry **UPR Medical Sciences Campus**
UPRCCC Investigator & Cancer Center Director
Chief Medical Officer **Pan American Center for Oncology Trials**

Male	Female	Total
63,564	60,923	124,487
82,504	80,601	163,105
94,139	90,688	184,827
105,002	100,291	205,293
110,616	107,734	218,350
107,468	108,194	215,662
85,899	93,181	179,080
91,299	102,195	193,494
94,228	104,813	199,041
98,025	107,936	205,961
100,527	115,826	216,353
100,359	117,821	218,180
95,430	112,683	208,113
85,438	103,428	188,866
77,896	95,172	173,068
55,835	70,662	126,497
36,846	49,971	86,817
31,937	54,223	86,160
1,517,012	**1,676,342**	**3,193,354**

Population pyramid by age groups and sex.

Age groups: 85+, 80-84, 75-79, 70-74, 65-69, 60-64, 55-59, 50-54, 45-49, 40-44, 35-39, 30-34, 25-29, 20-24, 15-19, 10-14, 5-9, 0-4

Population (%)

■ Male ■ Female

Median Income: 2022

	Puerto Rico	USA	Interpretation
Household	$ 24,112	$ 74,755	In comparison to USA, Puerto Rico has lower median income:
Family	$ 29,544	$ 92,148	
Female householder, no spouse present, with own children under 18 years	$ 12,840	$ 36,393	• The median income for households is 1/3 of the USA. • The median income for families is 1/3 of the USA. • The monthly median income for female householder, no spouse present, with own children under 18 years is $1,070.

Poverty: 2022

	Puerto Rico	USA	Interpretation
Population for whom poverty status is determined	**41.7%**	12.6%	In comparison to USA, Puerto Rico has more population living in poverty: • The poverty rate in Puerto Rico is three times of the USA. • 2 in 5 are poor • For every sex and age group, the percentage of poor population is higher in PR
AGE			
Under 18 years	**57.6%**	16.3%	
18 to 64 years	**38.1%**	11.7%	
65 years and over	**40.2%**	10.9%	
SEX			
Male	**39.4%**	11.4%	
Female	**43.8%**	13.8%	

Cancer in Puerto Rico

1st cause of death

> 70,000 Survivors

~17,000 new cases anually

~6,000 deaths anually

PRCCR – Founded in1951

Compulsory reporting by Law since 1990

Member of the National Program Cancer Registries, CDC (1997)

Puerto Rico

Lifetime Risk for Cancer in PR

Based on data for the period 2015-2019

2 in 5 people (41.4%)

Top ten cancer sites (incidence) by Sex:
2015-2019

| ♂ Male (N = 38,750)	%	APC[2000-2019]	♀ Female (N = 35,288)	%	APC[2000-2019]
Prostate	38.3	-0.1	Breast	29.7	↑ 1.6*
Colon and rectum	11.7	0.0	Colon and rectum	10.8	-0.2
Lung and bronchus	5.4	↓ -1.0*	Thyroid	10.5	↑ 9.0*
Urinary bladder	4.2	0.1	Corpus and uterus, NOS	9.2	↑ 4.6*
Non-Hodgkin Lymphoma	3.9	↑ 2.2*	Lung and bronchus	3.9	0.4
Oral cavity and pharynx	3.6	↓ -0.7*	Non-Hodgkin Lymphoma	3.9	↑ 2.2*
Liver and bile duct	3.4	↑ 1.7*	Cervix uteri	2.9	↑ 1.6*
Kidney and renal pelvis	3.1	↑ 4.2*	Pancreas	2.5	↑ 3.0*
Leukemia	2.8	↑ 2.1*	Leukemia	2.5	↑ 2.7*
Pancreas	2.4	↑ 3.4*	Ovary	2.3	↑ 0.8*
Other sites	21.2		Other sites	21.9	

Central Cancer Registry Incidence Case File (February 2, 2022). Incidence cases file population of 2017 are restricted to the first 6 months of the year (January to June). Cases from July to December were excluded due to the population change after hurricanes Irma and María.

Top ten cancer sites (mortality) by sex: 2015-2019

♂ Male (N = 14,175)	%	APC[2000-2019]	♀ Female (N = 11,526)	%	APC[2000-2019]
Prostate	16.4	↓ -3.4*	Breast	18.7	↓ -0.4*
Colon and rectum	13.1	↓ -0.9*	Colon and rectum	13.0	↓ -1.3*
Lung and bronchus	11.7	↓ -2.6*	Lung and bronchus	8.9	↓ -1.7*
Liver and bile duct	8.0	0.2	Pancreas	6.4	↑ 1.0*
Pancreas	6.0	↑ 1.4*	Corpus and uterus, NOS	5.5	0.9
Leukemia	3.7	↓ -1.3*	Liver and bile duct	4.7	↓ -1.7*
Stomach	3.7	↓ -4.9*	Ovary	4.4	-0.4
Oral cavity and pharynx	3.5	↓ -2.9*	Leukemia	3.9	↓ -1.1*
Non-Hodgkin Lymphoma	3.2	↓ -1.3*	Stomach	3.3	↓ -4.2*
Esophagus	3.0	↓ -4.3*	Non-Hodgkin Lymphoma	3.0	↓ -1.9*
Other sites	27.7		Other sites	28.3	

Age-Adjusted **Incidence Rates by Cancer Site**, Race & Ethnicity in PR and USA
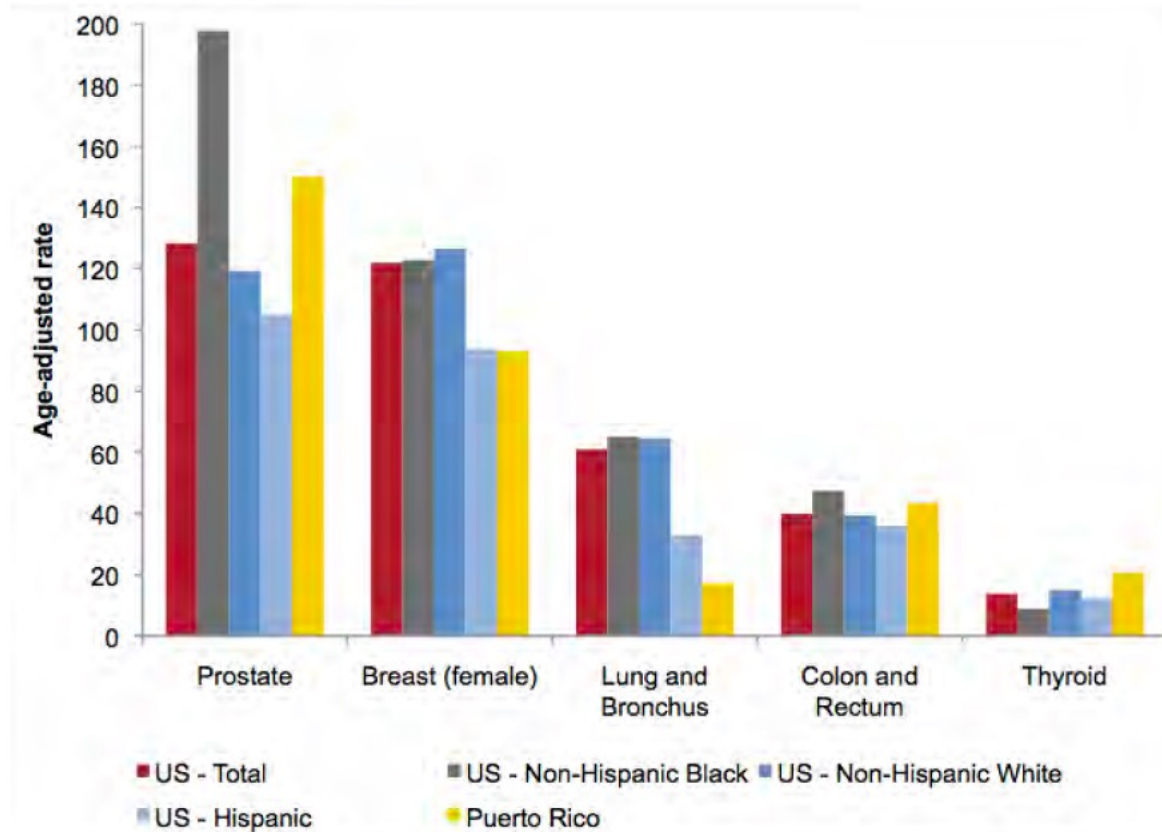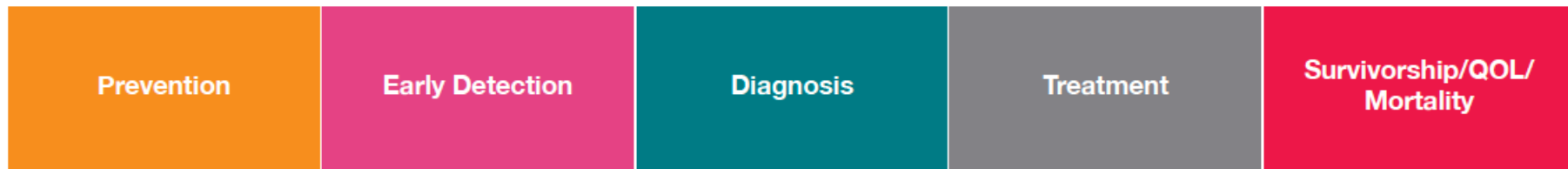
PUERTO RICO COMPREHENSIVE CANCER CONTROL PLAN

The Puerto Rico Comprehensive Cancer Control Plan (PRCCC Plan) is the document developed by the PRCCC in collaboration with the PRCCCP. The Plan is reviewed every five years to assess impact, update the burden of cancer and cancer-related risk factors, and update scientific progress, identify new evidence-based strategies and best practices, and select new priorities for cancer control. This document is a Call for Action and a Blueprint for coordinated cáncer control efforts in the island. The first PRCCC Plan was developed for the Period 2008-2012. It was presented to the Puerto Rican Community in September 2008, and began implementation in 2010.

The PRCCC Plan 2015-2020, is a strategic plan to reduce the cancer burden in the island through evidence-based strategies and best practices for cancer control. The Plan is designed to provide guidance to individuals and organizations interested in cancer control on priority areas to be addressed during the next five years, identify common goals and objectives, and provides a list of strategies in order to reach the proposed goals and objectives. The plan is organized based on the stages of the Cancer Control Continuum, from prevention to survivorship, and utilizes the Social-Ecological Model as a framework to impact at different levels (individual, interpersonal, organizational, community, and policy levels), Figure 3 and Figure 4.
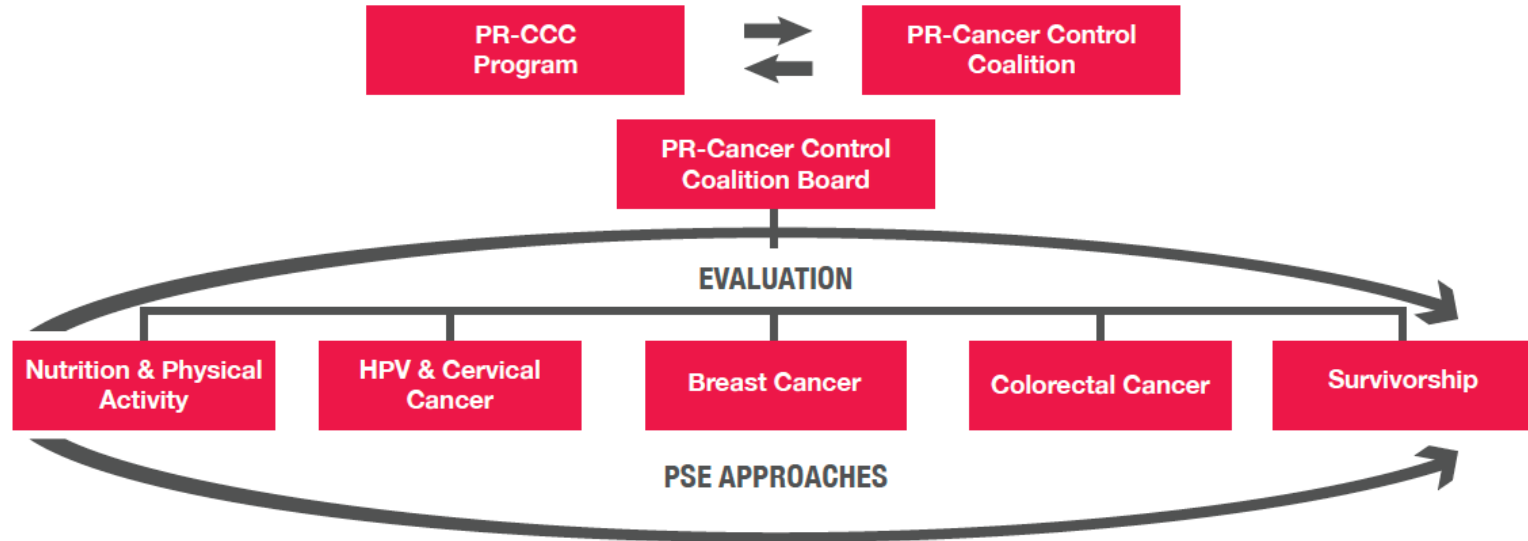
Figure 3Cancer Control Continuum

CANCER CONTROL CONTINUUM

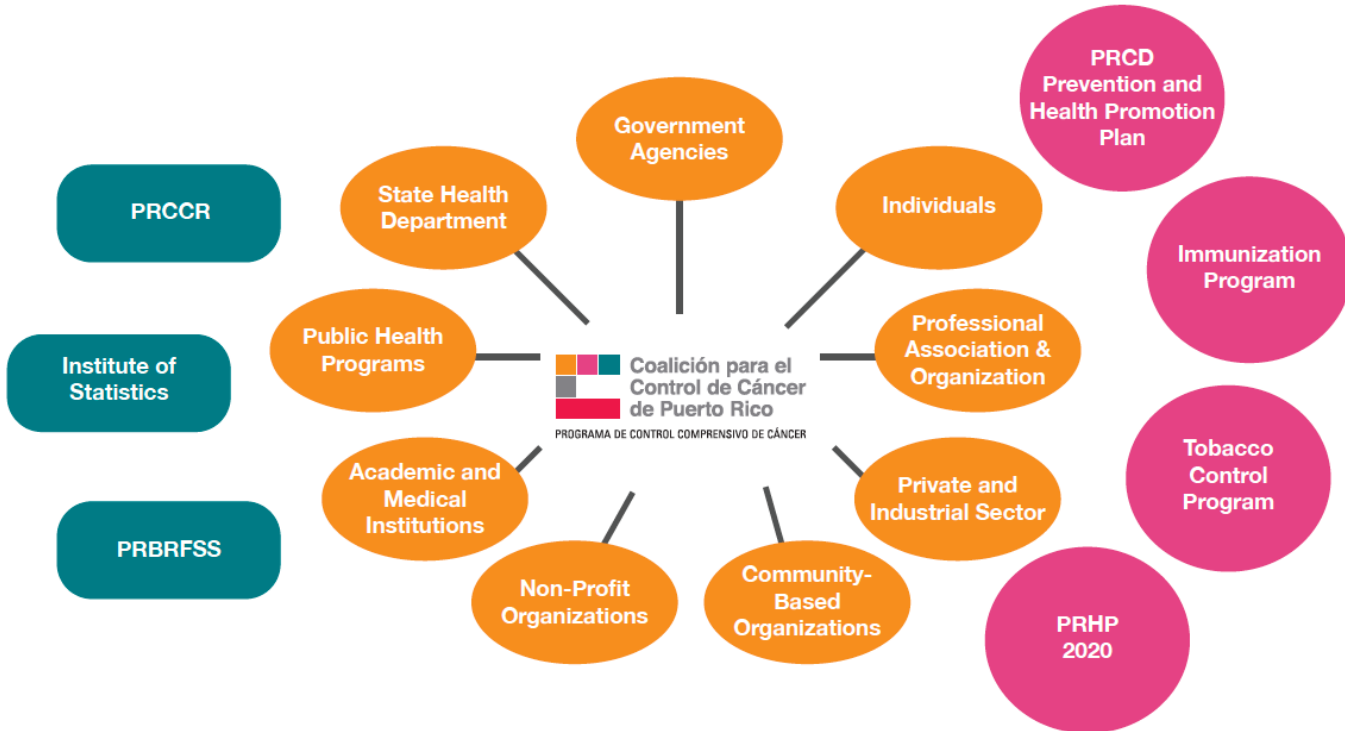| Prevention	Early Detection	Diagnosis	Treatment	Survivorship/QOL/Mortality

Puerto Rico Comprehensive Cancer Control Program (2020)

Figure 1 Puerto Rico Comprehensive Cancer Control Program

Puerto Rico Cancer Control Coalition

Cancer-Related Risk Factors
in the US and PR
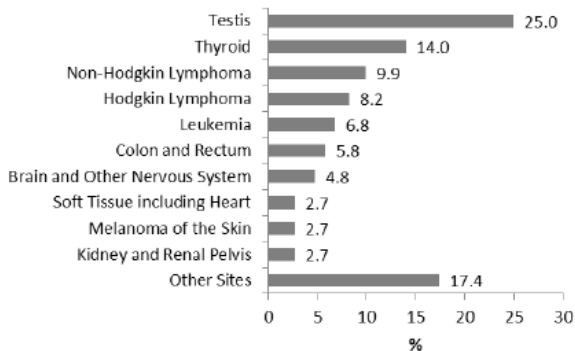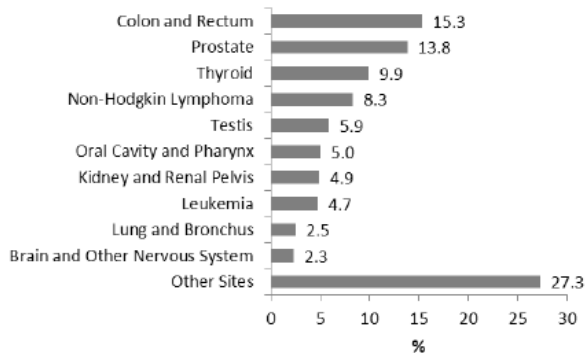## BRFSS

PREVENTION

Risk Factor	U.S. (Md %)	Puerto Rico
Diabetes	8.7%	12.8%*
Overweigh/Obesity	63.4%	66.2%
Physical Activity last month	77.1%	57.6%$
Fruit & Vegetables 5+/day	23.4%	17.7%$
Current Smokers	19.6%	12.6%$

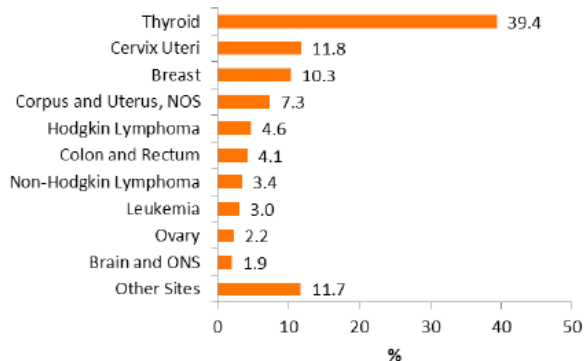# Most **Frequently Diagnosed Cancers** in PR, Ages 20-34 (2014-2019)
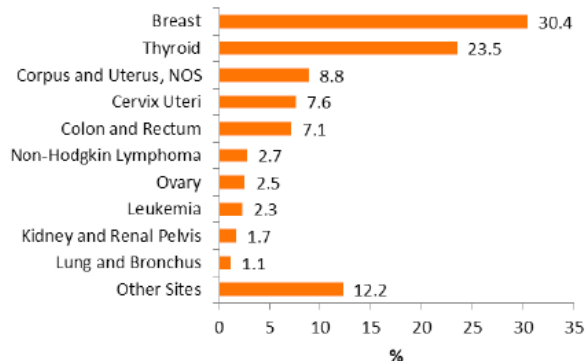

Males, 20-34 years (N=777)

Site	%
Testis	25.0
Thyroid	14.0
Non-Hodgkin Lymphoma	9.9
Hodgkin Lymphoma	8.2
Leukemia	6.8
Colon and Rectum	5.8
Brain and Other Nervous System	4.8
Soft Tissue including Heart	2.7
Melanoma of the Skin	2.7
Kidney and Renal Pelvis	2.7
Other Sites	17.4

Males, 35-49 years (N=2,235)

Site	%
Colon and Rectum	15.3
Prostate	13.8
Thyroid	9.9
Non-Hodgkin Lymphoma	8.3
Testis	5.9
Oral Cavity and Pharynx	5.0
Kidney and Renal Pelvis	4.9
Leukemia	4.7
Lung and Bronchus	2.5
Brain and Other Nervous System	2.3
Other Sites	27.3

Females, 20-34 years (N=1,337)

Site	%
Thyroid	39.4
Cervix Uteri	11.8
Breast	10.3
Corpus and Uterus, NOS	7.3
Hodgkin Lymphoma	4.6
Colon and Rectum	4.1
Non-Hodgkin Lymphoma	3.4
Leukemia	3.0
Ovary	2.2
Brain and ONS	1.9
Other Sites	11.7

Females, 35-49 years (N=5,032)

Site	%
Breast	30.4
Thyroid	23.5
Corpus and Uterus, NOS	8.8
Cervix Uteri	7.6
Colon and Rectum	7.1
Non-Hodgkin Lymphoma	2.7
Ovary	2.5
Leukemia	2.3
Kidney and Renal Pelvis	1.7
Lung and Bronchus	1.1
Other Sites	12.2

Most **Frequently Diagnosed Cancers** in PR, Ages 50-64 2014-2019

Males, 50-64 years (N=10,926)

Cancer Site	%
Prostate	40.6
Colon and Rectum	13.0
Oral Cavity and Pharynx	4.9
Lung and Bronchus	4.3
Liver and Bile Duct	3.8
Non-Hodgkin Lymphoma	3.7
Kidney and Renal Pelvis	3.7
Thyroid	3.1
Urinary Bladder	2.8
Pancreas	2.4
Other Sites	17.8

Males, 65-79 years (N=18,188)

Cancer Site	%
Prostate	44.0
Colon and Rectum	11.4
Lung and Bronchus	6.1
Urinary Bladder	4.1
Oral Cavity and Pharynx	3.4
Liver and Bile Duct	3.3
Non-Hodgkin Lymphoma	3.2
Kidney and Renal Pelvis	2.5
Pancreas	2.4
Leukemia	2.3
Other Sites	17.3

Females, 50-64 years (N=10,529)

Cancer Site	%
Breast	33.1
Corpus and Uterus, NOS	12.5
Thyroid	12.1
Colon and Rectum	10.6
Non-Hodgkin Lymphoma	3.5
Lung and Bronchus	2.9
Cervix Uteri	2.8
Ovary	2.5
Kidney and Renal Pelvis	2.0
Myeloma	1.7
Other Sites	16.3

Females, 65-79 years (N=12,504)

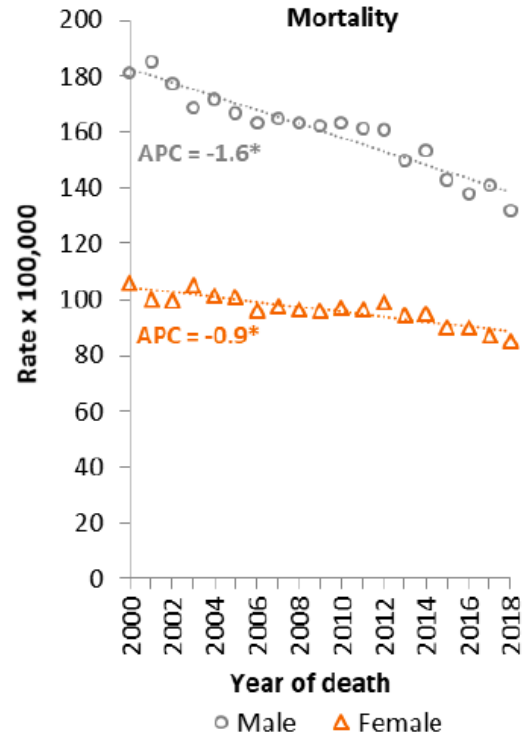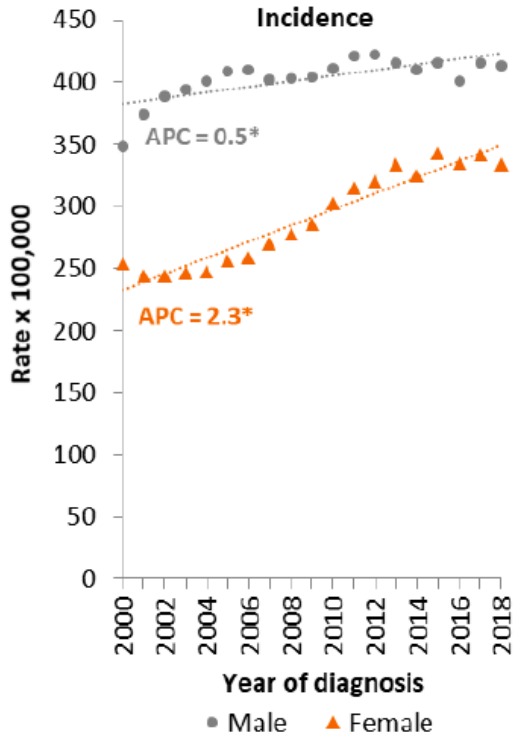| Cancer Site	%
Breast	31.0
Colon and Rectum	12.0
Corpus and Uterus, NOS	8.7
Thyroid	5.5
Lung and Bronchus	5.3
Non-Hodgkin Lymphoma	4.4
Pancreas	2.8
Myeloma	2.6
Stomach	2.3
Leukemia	2.3
Other Sites	23.2
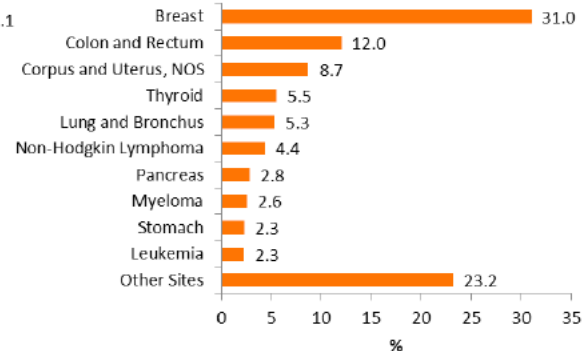
Age-Specific **Incidence** and **Mortality** Rates
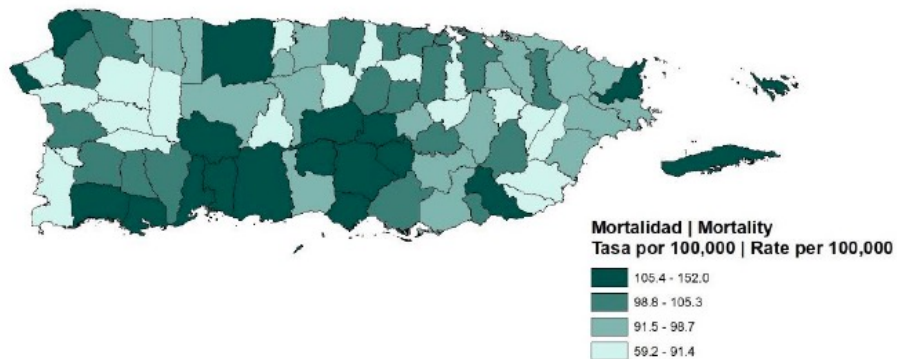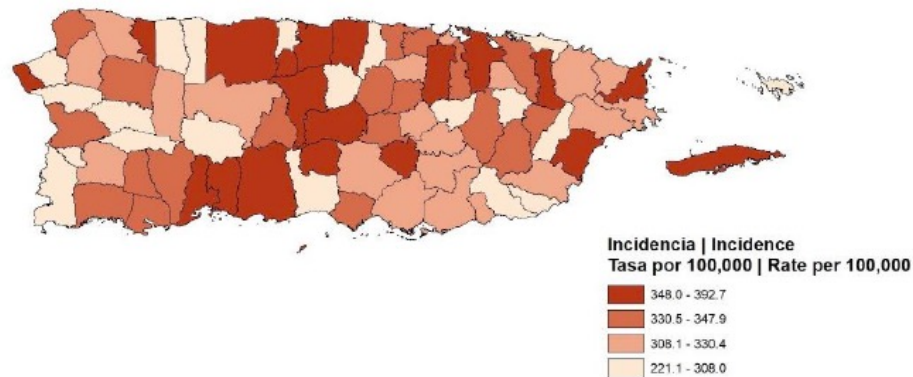## All Cancers by Sex (2004-2019)
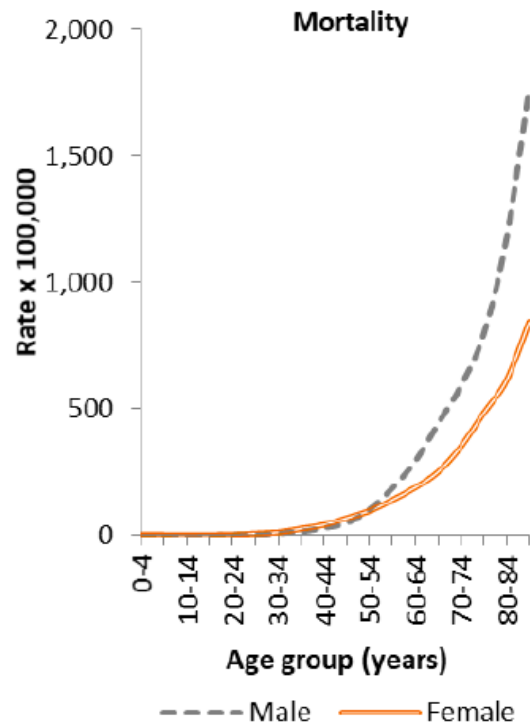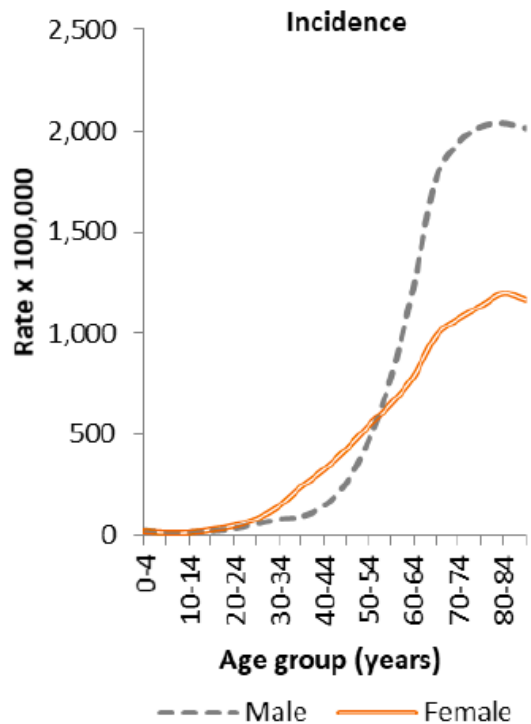
Age-Adjusted **Incidence & Mortality Trends** – **All Cancer Sites by Sex** (2000-2018)

Age-Adjusted **Incidence & Mortality Rates –**
# **All Cancer Sites by Municipality** (2014-2019)

Incidencia | Incidence
Tasa por 100,000 | Rate per 100,000

- 348.0 - 392.7
- 330.5 - 347.9
- 308.1 - 330.4
- 221.1 - 308.0

Mortalidad | Mortality
Tasa por 100,000 | Rate per 100,000

- 105.4 - 152.0
- 98.8 - 105.3
- 91.5 - 98.7
- 59.2 - 91.4

Most Frequently Diagnosed Cancers Among Children in PR by Sex
(2014-2019)

| ♂ Boys (N = 327)	%	APC$^{2000-2018}$	♀ Girls (N = 348)	%	APC$^{2000-2018}$
Leukemias	21.4	1.9	Carcinomas	31.0	↑ 12.5*
Lymphomas	17.1	↑ 2.9*	Leukemias	21.6	↑ 4.2*
CNS Neoplasms	16.8	↑ 2.6*	CNS Neoplasms	11.5	0.0
Carcinomas	12.2	↑ 10.8*	Lymphomas	11.2	↑ 4.1*
Germ Cell Neoplasms	7.6	↑ 4.8*	Germ Cell Neoplasms	5.7	3.0
Other sites	24.8		Other sites	19.0	

CNS = Central Nervous System
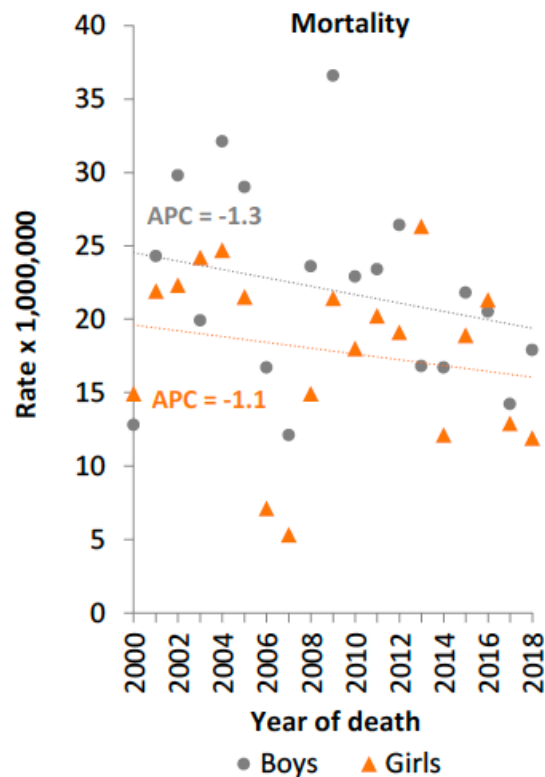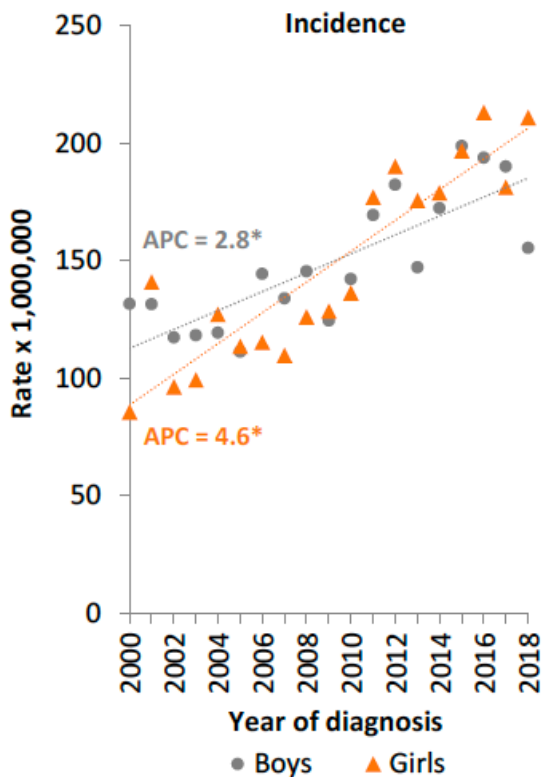
Age-Adjusted Incidence & Mortality Rates –
Prostate & Female Breast Cancer (2000-2018)
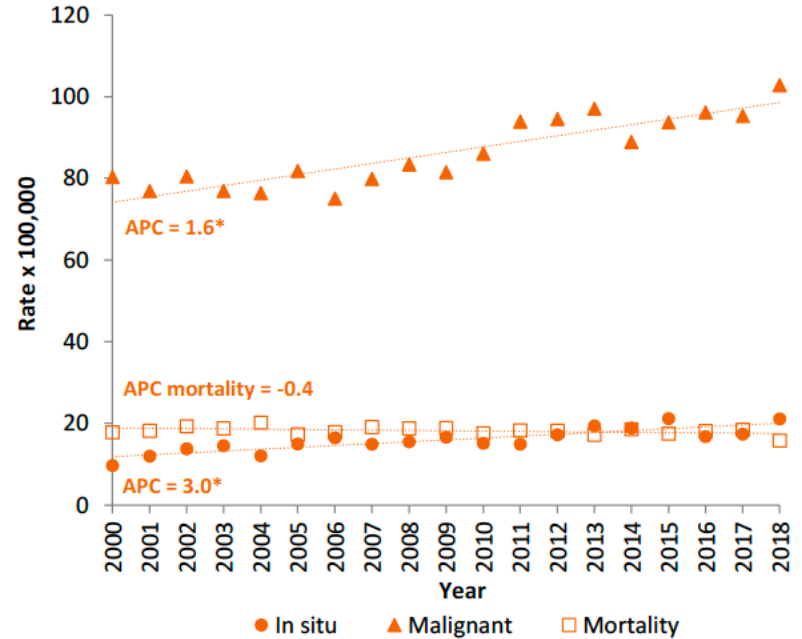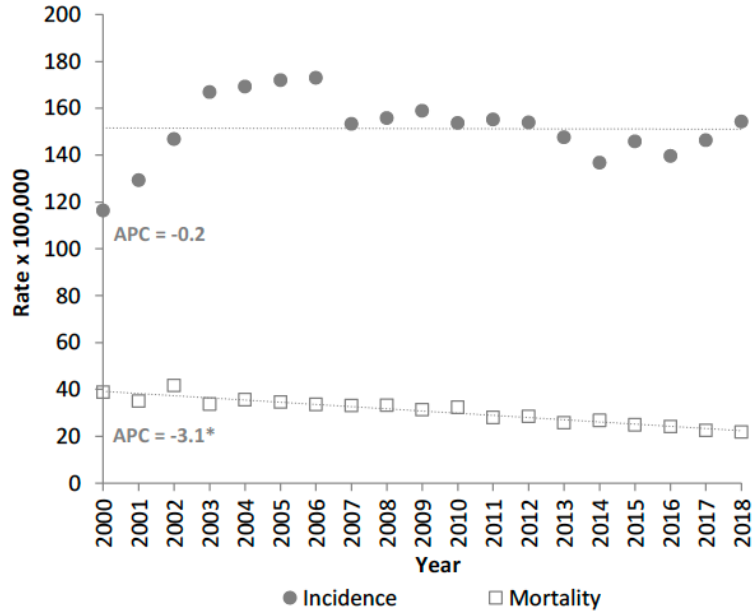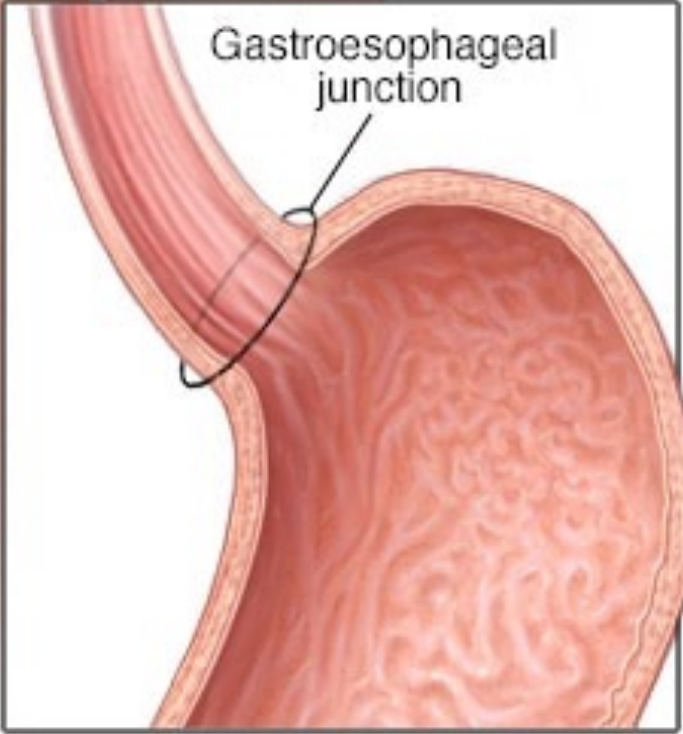
- 13th most commonly diagnosed malignancy in PR

- 2.3% of all cancers in men and 2.0% of all cancers in women

- 3.8% of all cancer deaths in men and 3.4% of all cancer deaths in women
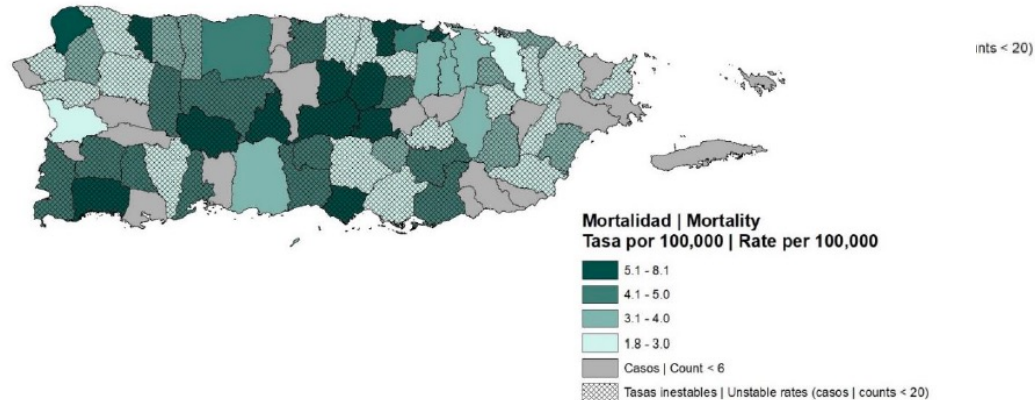- 6th & 9th leading cause of cancer death among men and women, respectively

Stomach
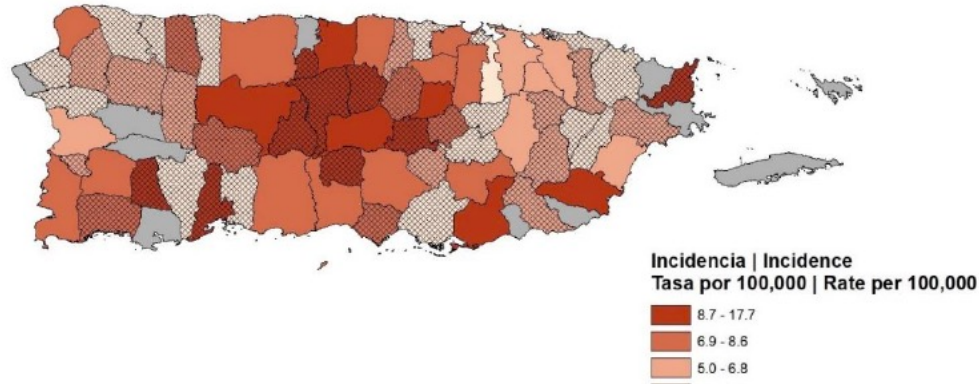
Gastroesophageal junction

©2017
MAYO

Age-Adjusted Incidence & Mortality Rates
Gastric Cancer by Municipality (2014-2019)

Incidencia | Incidence
Tasa por 100,000 | Rate per 100,000
- 8.7 - 17.7
- 6.9 - 8.6
- 5.0 - 6.8

Mortalidad | Mortality
Tasa por 100,000 | Rate per 100,000
- 5.1 - 8.1
- 4.1 - 5.0
- 3.1 - 4.0
- 1.8 - 3.0
- Casos | Count < 6
- Tasas inestables | Unstable rates (casos | counts < 20)

Cancer Medicine Open Access **WILEY**

RESEARCH ARTICLE

Racial/ethnic disparities in gastric cancer: A 15-year population-based analysis

Maria Gonzalez-Pons[1] | Carlos R. Torres-Cintrón[2] | Marievelisse Soto-Salgado[3] |
Yimari Vargas-Ramos[1] | Luis Perez-Portocarrero[4] | Douglas R. Morgan[5] |
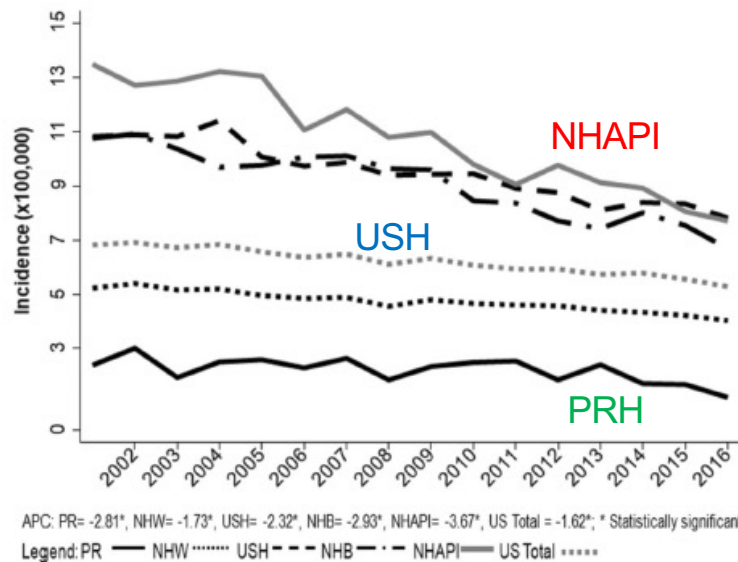Marcia Cruz-Correa[6,7]

APC: PR= -2.81*, NHW= -1.73*, USH= -2.32*, NHB= -2.93*, NHAPI= -3.67*, US Total = -1.62*; * Statistically significant
Legend: PR ——— NHW ········· USH – – – NHB – · – · NHAPI ———— US Total ·····

TABLE 2 Age-standardized incidence rates (per 100,000) for gastric cancer from 2012 to 2016

	Age-standardized rates[a]						RR (95% CI)[b]				
	PR	**NHW**	**USH**	**NHB**	**NHAPI**	**U.S. overall**	**PR vs. NHW**	**PR vs. USH**	**PR vs. NHB**	**PR vs. NHAPI**	**PR vs. U.S. overall**
Overall	5.68	4.33	8.25	7.47	8.66	5.65	1.31 (1.26–1.37)	0.69 (0.66–0.72)	0.76 (0.73–0.80)	0.66 (0.63–0.69)	1.00 (0.96–1.05)
Male	7.82	6.55	10.68	10.78	11.58	8.02	1.19 (1.13–1.26)	0.73 (0.69–0.78)	0.73 (0.68–0.77)	0.68 (0.64–0.72)	0.97 (0.93–1.03)
Female	4.03	2.48	6.38	5.17	6.44	3.74	1.63 (1.52–1.74)	0.63 (0.59–0.68)	0.78 (0.72–0.84)	0.63 (0.58–0.67)	1.08 (1.01–1.15)

Note: Abbreviations: NHAPI, non-Hispanic Asian or Pacific Islanders; NHB, non-Hispanic black; NHW, non-Hispanic white; PR, Puerto Ricans; U.S. overall, All U.S. racial/ethnic groups; USH, U.S. Hispanics.

[a] Age-standardized rates using the U.S. 2000 standard population.

[b] SSR indicated standardized rate ratio with a 95% confidence interval.

Increase in APC for GC < Age 50 among PRH

TABLE 3 Annual percent change (APC) in gastric cancer incidence by race/ethnic group 2002–2016

	PRH	NHW	NHB	NHAPI	USH
	APC (CI)	APC (CI)	APC (CI)	APC (CI)	APC (CI)
Overall	−2.8[a] (−4.8 to −0.7)	−1.6[a] (−1.9 to −1.4)	−2.9[a] (−3.5 to −2.4)	−3.7[a] (−4.2 to −3.1)	−2.3[a] (−2.7 to −1.9)
Age group					
<50	4.2 (−2.0 to 10.9)	−0.5 (−1.4 to 0.4)	−2.1[a] (−3.0 to −1.2)	−2.6[a] (−4.0 to −1.3)	0.4 (−0.3 to 1.1)
50+	−3.2[a] (−5.3 to −1.1)	−1.7[a] (−2.0 to −1.5)	−3.0[a] (−3.6 to −2.4)	−3.8[a] (−4.4 to −3.2)	−2.7[a] (−3.1 to −2.3)
Sex					
Male	−2.6 (−5.3 to 0.3)	−1.7[a] (−2.1 to −1.4)	−3.2[a] (−3.9 to −2.4)	−3.7[a] (−4.3 to −3.1)	−2.5[a] (−3.1 to −1.9)
Female	−3.5[a] (−5.8 to −1.1)	−1.9[a] (−2.3 to −1.5)	−2.8[a] (−3.7 to −1.9)	−3.7[a] (−4.4 to −3.0)	−2.2[a] (−2.8 to −1.6)
Stage at diagnosis					
Localized	−5.1[a] (−6.3 to −3.9)	−0.6[a] (−1.2 to 0.0)	−3.2[a] (−4.2 to −2.1)	−3.9[a] (−5.1 to −2.6)	−2.2[a] (−3.4 to −1.0)
Regional	1.6[a] (0.0 to 3.2)	−3.3[a] (−3.8 to −2.7)	−4.3[a] (−5.4 to −3.1)	−5.3[a] (−6.1 to −4.5)	−3.9[a] (−4.6 to −3.2)
Distant	−6.2[a] (−8.1 to −4.3)	−0.3 (−0.8 to 0.1)	−1.3[a] (−2.2 to −0.3)	−2.3[a] (−3.2 to −1.5)	−1.0[a] (−1.7 to −0.3)

Note: The 95% confidence interval is given in *parentheses*.
[a]Annual percent change (APC) is significantly different from zero at the alpha = 0.05 level.

✓ Overall GC incidence have been **decreasing** (2002-2016)
✓ *Racial/Ethnic* disparities continue: Highest rates for NHB, NHAPI, USH
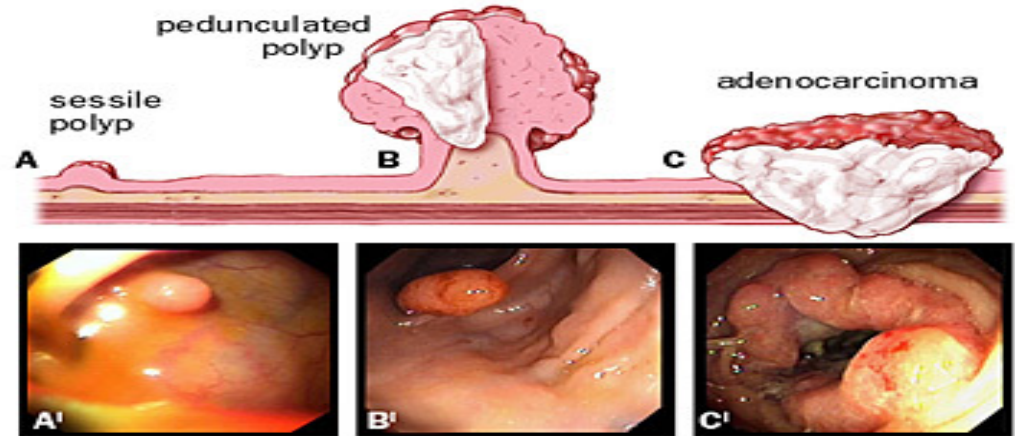✓ > GC among PRH <50 years old (*Autoinmune? Hereditary GC?*)

Colorectal Cancer

1st cause of cancer death in Puerto Rico
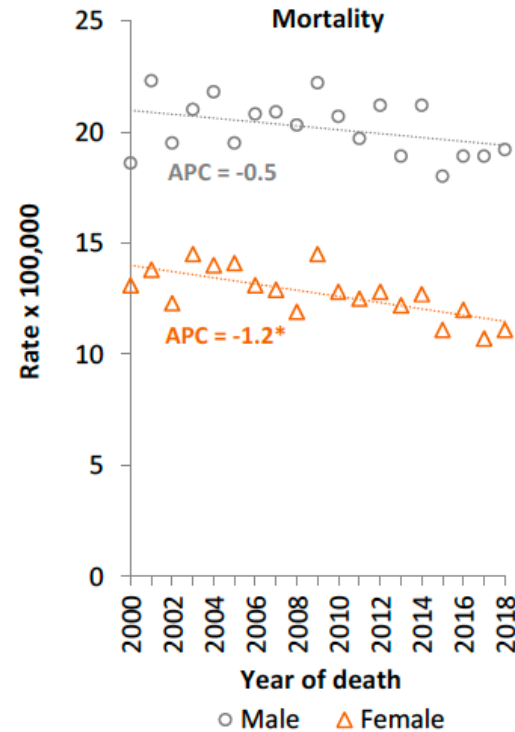
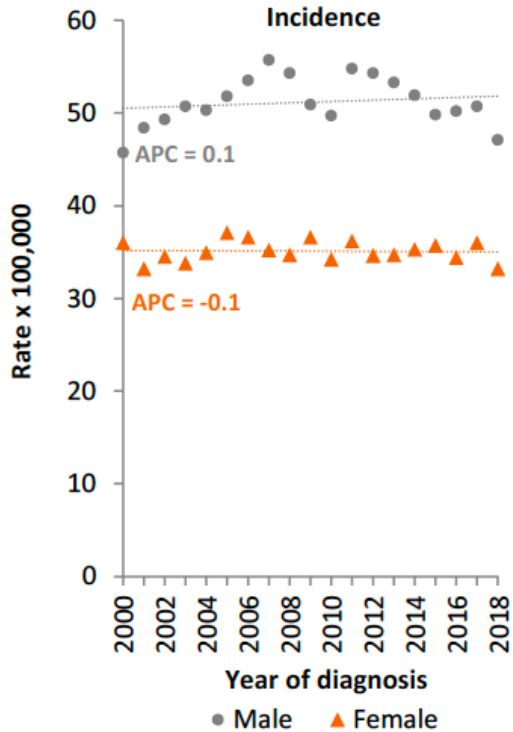**2nd** cause of cancer in US Latinos
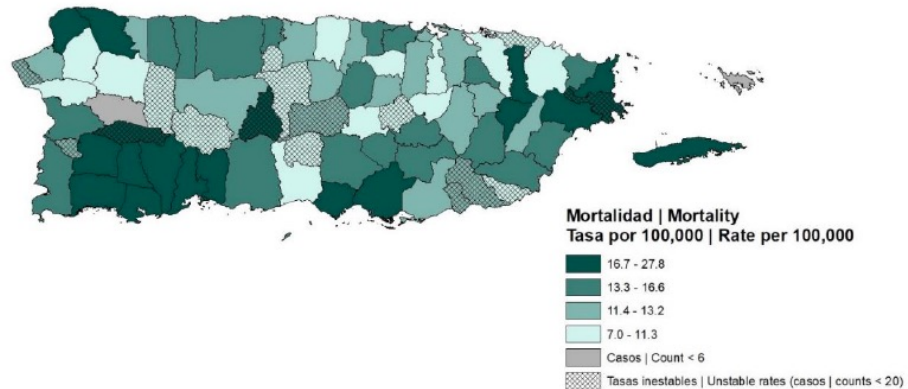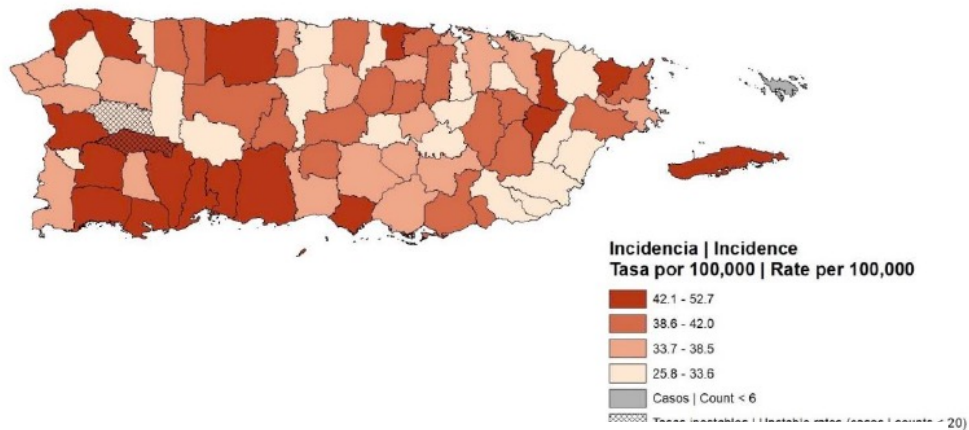
3rd cause of cancer worldwide

4th cause of cancer related death worldwide

Age-Adjusted Incidence & Mortality Rates – **Colorectal Cancer by Sex** (2000-2018)

Age-Adjusted Incidence Rates
Colorectal Cancer by Municipality (2014-2019)

Incidencia | Incidence
Tasa por 100,000 | Rate per 100,000

- 42.1 - 52.7
- 38.6 - 42.0
- 33.7 - 38.5
- 25.8 - 33.6
- Casos | Count < 6
- Tasas inestables | Unstable rates (casos | counts < 20)

Mortalidad | Mortality
Tasa por 100,000 | Rate per 100,000

- 16.7 - 27.8
- 13.3 - 16.6
- 11.4 - 13.2
- 7.0 - 11.3
- Casos | Count < 6
- Tasas inestables | Unstable rates (casos | counts < 20)

Cancer Databases Studied

The Cancer Genome Atlas (NCI) (n=594)

Genomics Evidence Neoplasia Information Exchange (GENIE) (n=724)

Precision Oncology Alliance (n=218)

Mutational frequencies of top mutated genes specific alterations in PRH compared to TCGA, GENIE-NH and GENIE-H
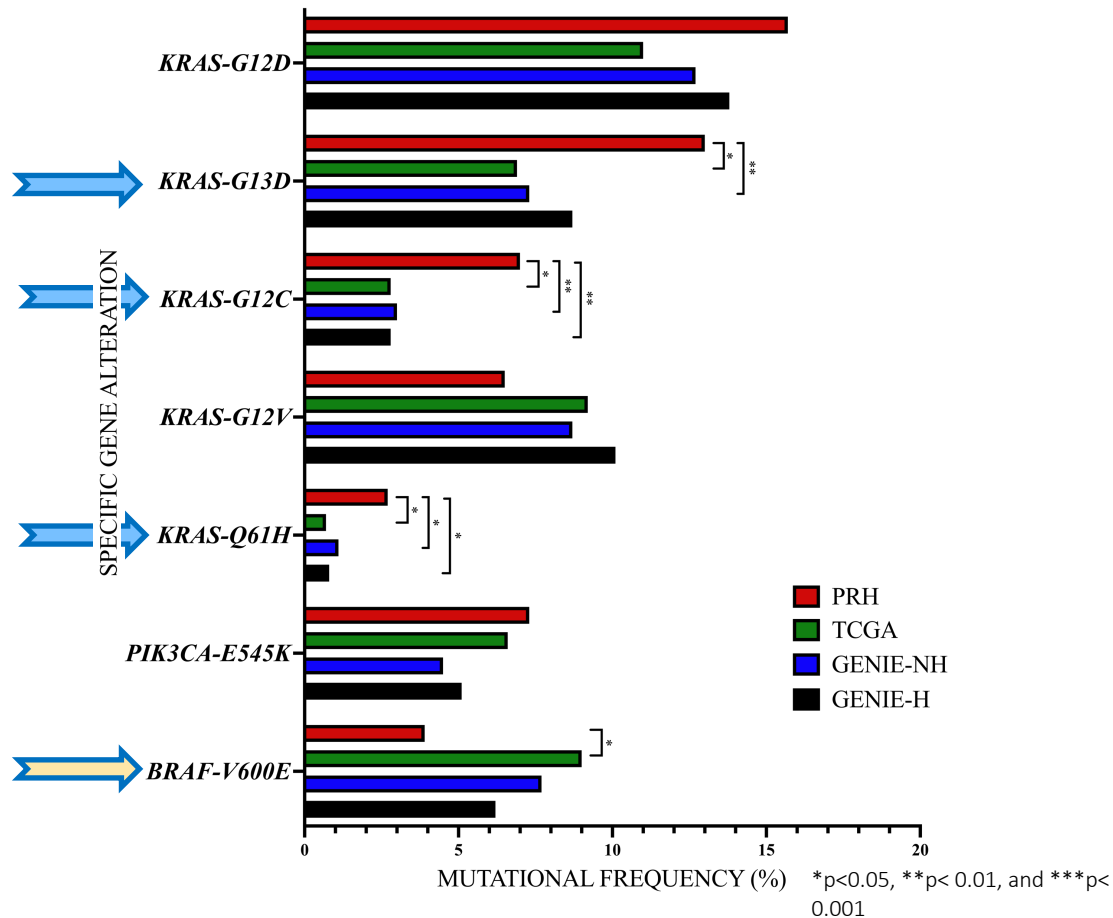

Actionable genes
❖ BRAF V600E - Encorafenib + Cetuximab

❖ KRAS G12C, G13D and Q61H oncogenic mutations.
  ❖ Several drugs have entered clinical trials targeting mutation at codons 12, 13 and 61.
  ❖ Sotorasib - several clinical trials are evaluating this drug for the treatment of mCRC patients
    ❖ targets the KRAS G12C mutant and it was recently approved for treatment NSCLC

Ancestry and Colorectal Cancer Risk

Human Genomics

Association of genetic ancestry with colorectal tumor location in Puerto Rican Latinos

Check for updates

Julyann Pérez-Mayoral[1], Marievelisse Soto-Salgado[2], Ebony Shah[3], Rick Kittles[4], Mariana C. Stern[5], Myrta I. Olivera[1], María Gonzalez-Pons[1], Segundo Rodriguez-Quilichinni[6], Marla Torres[7], Jose S. Reyes[7], Luis Tous[7], Nicolas López[7], Victor Carlo Chevere[8] and Marcia Cruz-Correa[1,4*]
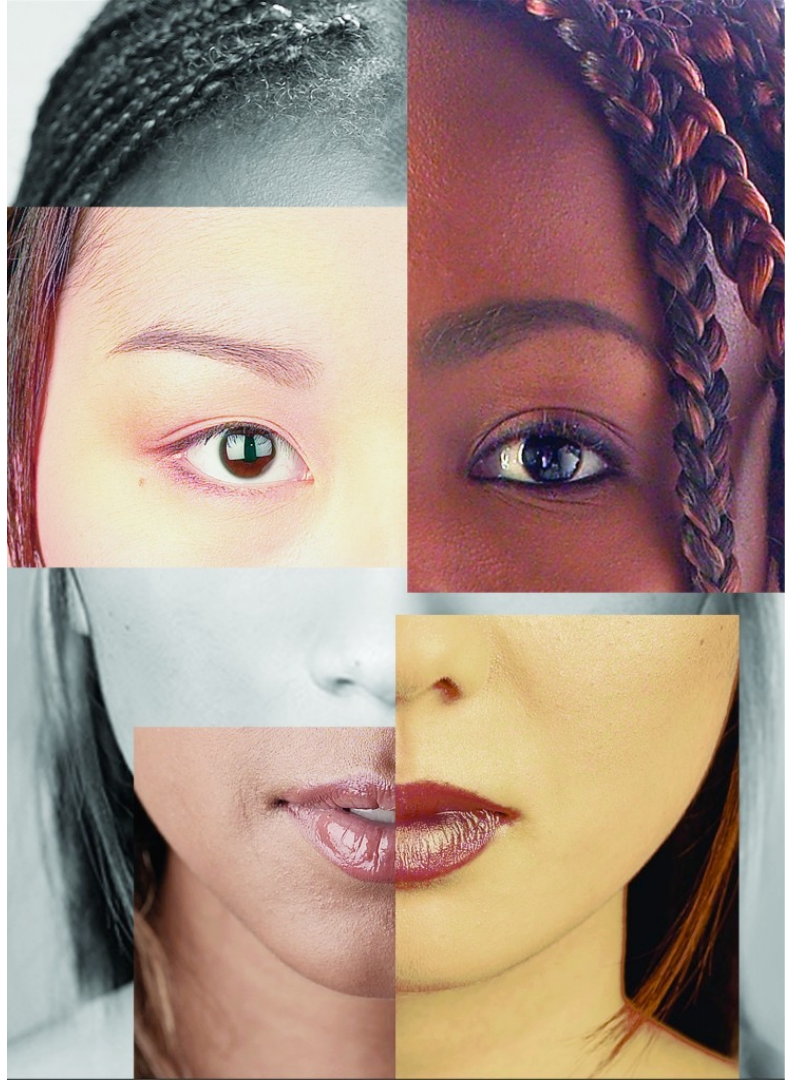
Genetic Ancestry & CRC in PR Hispanics

Julyann Perez-Mayoral
Office of Cancer Genomics NCI
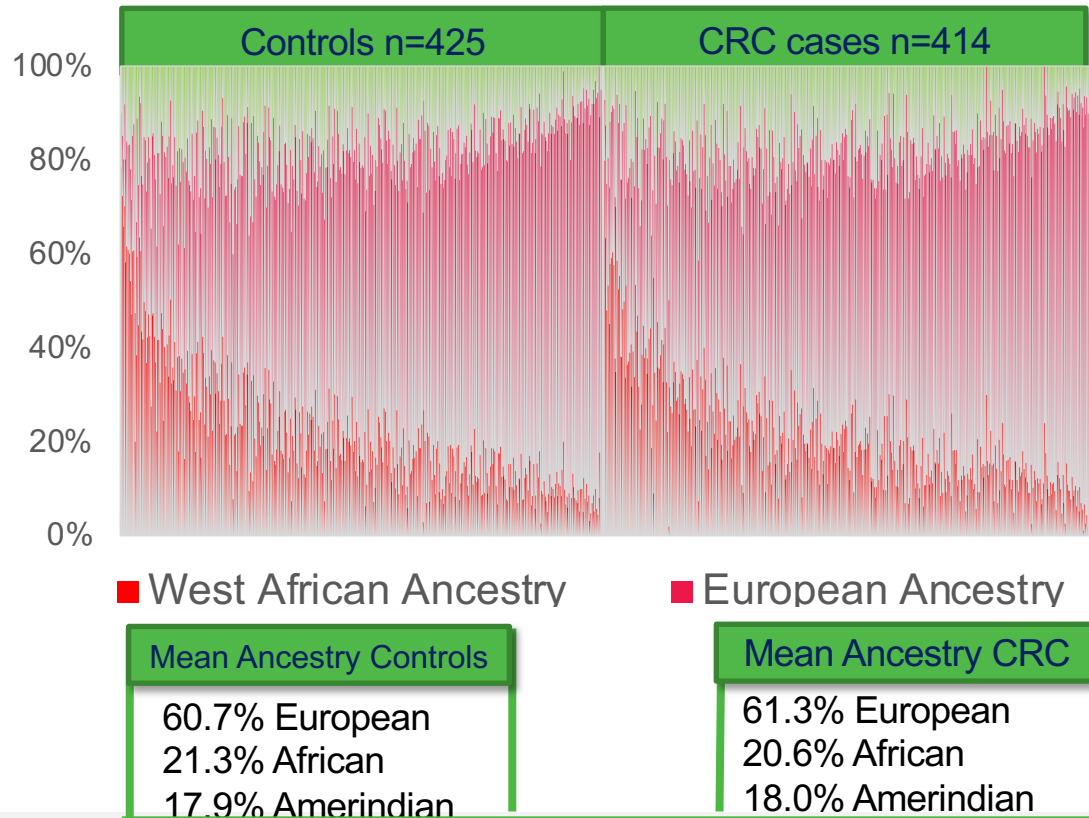
African Ancestry Associated with <u>Distal </u>location & <u>Poor Tumor </u>Differentiation

Tumor Characteristic	≤0.20 n(%)	>0.20 n(%)	p-value	Odds Ratio	p-value
Age at Diagnosis					
<60 years	120 (50.85)	116 (49.15)	0.301	1.0	0.320
≥60 years	86 (56.21)	67 (43.79)		0.82 (0.54-1.22)	
Tumor Location					
Proximal Colon	52 (26.67)	19 (13.67)	**0.004**	1.0	**0.006**
Distal Colon	143 (73.33)	120 (86.33)		**2.20 (1.25-3.84)**	
Tumor differentiation					
High	46 (30.07)	12 (12.37)	**0.005**	1.0	
Moderate	92 (60.13)	74 (76.29)		**3.08 (1.52-6.24)**	**0.002**
Low	15 (9.80)	11 (11.34)		**2.81 (1.02-7.67)**	**0.044**

Perez-Mayoral et al. Human Genomics 2019

Mutations in *KRAS/BRAF* and MSI *were not* associated with African Ancestry

Summary

• The Burden of cancer in Puerto Rico is high, associated to multiple environmental risk factors and lifestyle behaviors

• Social determinants of health including access to health care services in a timeline manner are key aspects addressed as part of the PR Cancer Control Plan

• Understanding cancer epidemiological trends help guide research & health policies

Acknowledgements

o **Patients and their family members** who have participated in PURIFICAR and all clinical research studies

o **Gastrointestinal Genetics Epidemiology Network**