Regional Variation in Preterm Birth and Associated Risk Factors in Texas (2008-2011)

A County Level Analysis Using Geographic Information Systems

Conflict of Interest Disclosure

The following individuals have reported *NO* financial relationships with commercial interests (drug/device companies):

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Public Health Significance

Preterm birth (PTB) is:

- a leading cause of infant mortality and infant and child morbidity

- a factor in driving disparities in infant mortality

- costly to families, the health care system and society, ~ $54,150/PTB*

*March of Dimes, Premature birth: The financial impact on business 12/13
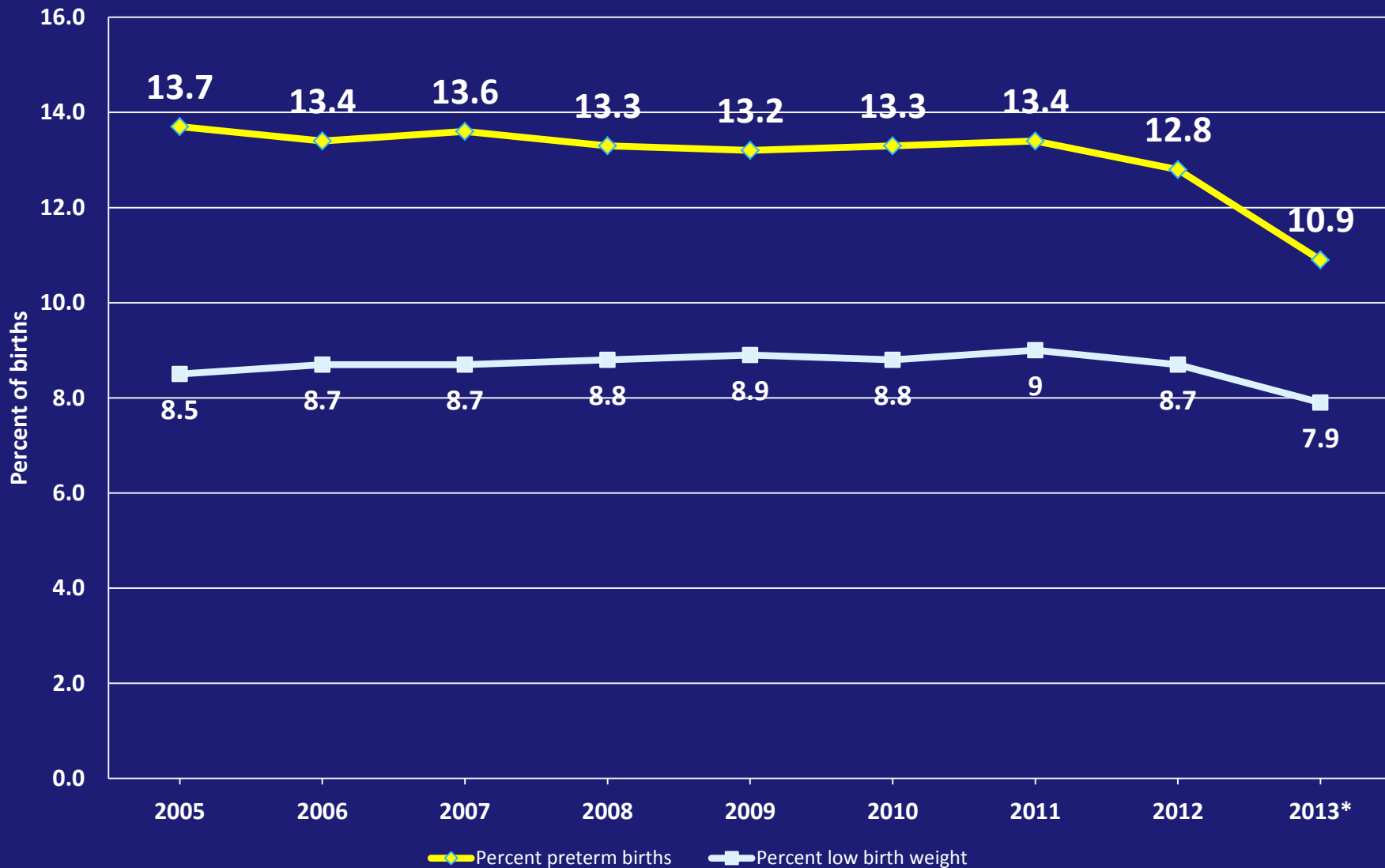
Public Health Significance

- Infant born too early are at increased risk for:
  - Respiratory problems including asthma
  - Neuro-developmental disabilities
  - Necrotizing enterocolitis
  - Infections
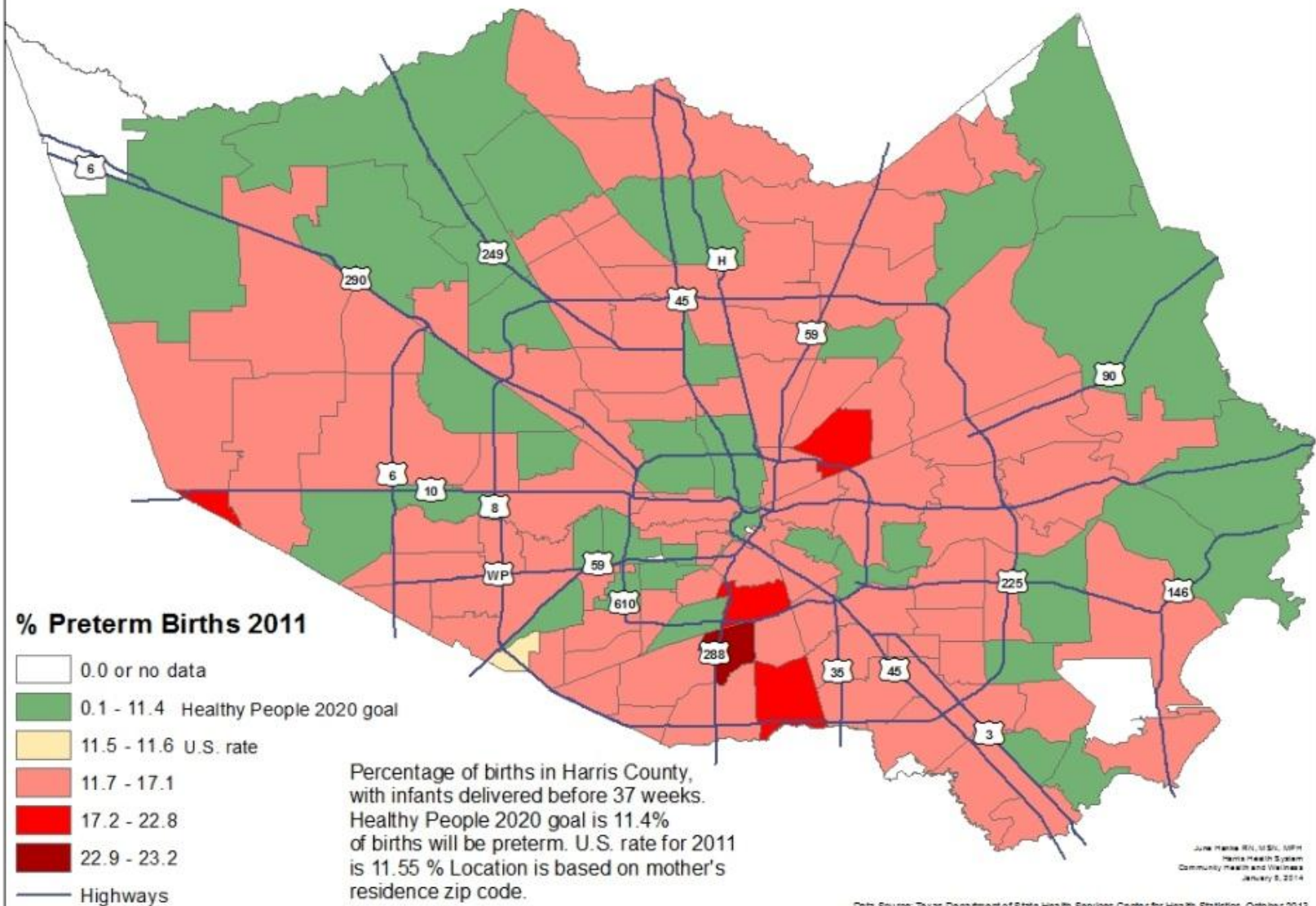 - Cardiovascular disorders

IOM, (2007) Preterm birth, causes, consequences and prevention

Preterm Birth in Texas
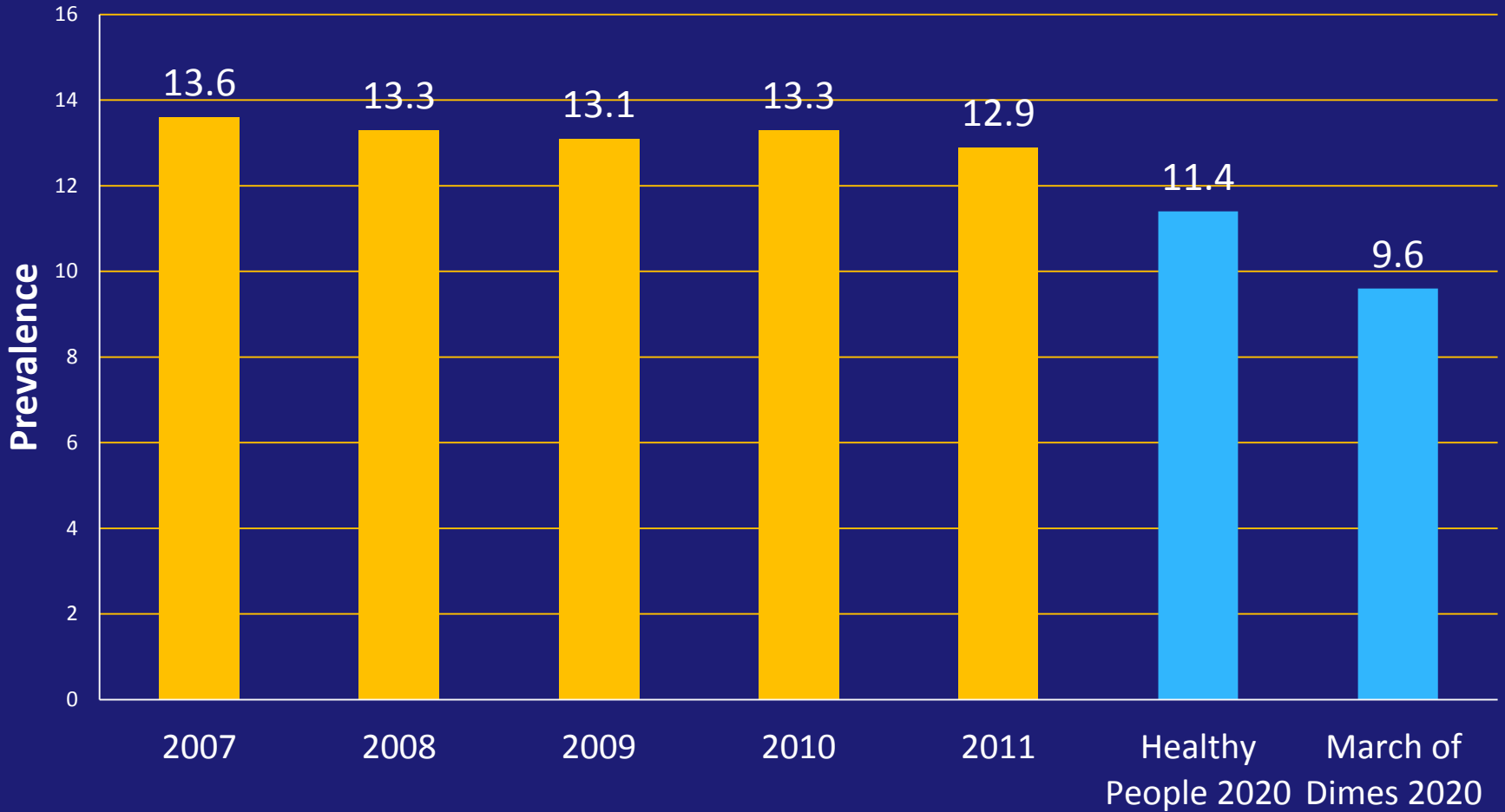
PTB: all births less than 37 weeks gestation

Low Birth Weight and Premature Births (all births): Harris County, 2005-2013

Data Source Texas Department of State Health Services Center for Health Statistics. * 2013 Preliminary Data

Harris County 2011 Preterm Births

% Preterm Births 2011

- ☐ 0.0 or no data
- ■ 0.1 - 11.4 Healthy People 2020 goal
- ■ 11.5 - 11.6 U.S. rate
- ■ 11.7 - 17.1
- ■ 17.2 - 22.8
- ■ 22.9 - 23.2
- ── Highways

Percentage of births in Harris County, with infants delivered before 37 weeks. Healthy People 2020 goal is 11.4% of births will be preterm. U.S. rate for 2011 is 11.55 % Location is based on mother's residence zip code.

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Data Source: Texas Department of State Health Services Center for Health Statistics, October 2013

Objectives

- Describe key risk factors for PTB.

- Identify areas of Harris County Texas disproportionately affected by PTB using Geographic Information System (GIS).

- Describe contribution of maternal risk factors across different rate categories of PTB in the county.

Methods

- **Study design**: retrospective cross-sectional analysis

- **Time frame**: PTBs that occurred in Texas between 2008 and 2011 to characterize burden of PTB and its associated risk factors.

- **Data source**: Vital statistics data was obtained from the Texas Department of State Health Services for the years 2008 through 2011.

- **Additional data**: Socio-demographic and behavioral risk factor data were obtained from birth certificates and census track data from the American Community Survey

Methods Continued

- **Characterization PTB prevalence**: GIS to locate areas most affected by PTB using latitude and longitude coordinates to do spatial analysis statistics.

- **Analytic Sample**: Singleton births for 379,141 women

- **PTB classification**: births <37 weeks gestational age.

- **Statistical analysis**: Multivariable logistic regression models were used to determine county-level, and low, medium and high risk areas with in the county for contribution of maternal risk factors with PTB.

- We also looked at risk factors for the area of county with the highest numbers of PTB, which is different from the area with the highest rates.

Birth Data

- Essentially complete, all births, data for an eight-county region – Harris County and the seven contiguous counties

- Four years of data, 2008 to 2011.

- 379,141 total number of cases for all four years

- 366,095 singleton cases for all four years

- Aged 13 – 47 years

- Cases were geocoded, using the mother's residential address, by the Texas Department of State Health Services, Center for Health Statistics, to an unmasked longitude (x) and latitude (y) - point level of geography

Geocoding Accuracy

- Overall geocoding accuracy, by geographic level:
  - Street – 97.1% (368,058)
  - ZIP + 4 – 1.2% (4,570)
  - Not Geocoded – 1.7% (6,513)
- For singleton births:
  - Street – 97.1% (355,404)
  - ZIP + 4 – 1.2% (4,402)
  - Not Geocoded – 1.7% (6,289)
- All geocoded cases were used

Spatial Analysis

- Used dual kernel density estimation (KDE) – ratio of densities
  - The program used for this presentation is CrimeStat 4.01 (freeware available from the Department of Justice, Ned Levine PhD, author)
  - Dual kernel density estimates were designed to give a ratio of densities
    - Primary file (numerator) has all geocoded singleton PTBs
    - Secondary file (denominator) has all geocoded singleton births
  - We assumed a normal distribution

- Cell size and bandwidth were optimized for Harris County/City of Houston area size and population density and to reduce or eliminate "false hotspots" – Type 1, false positive results
  - Kernel cell size is approximately 600 x 600 meters
  - Fixed bandwidth of 1500 meters was chosen for the search radius

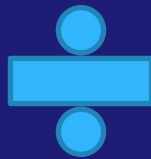- Spatial autocorrelation (Geary's C) did not test to be significant

Kernel: approximately 600 meters square

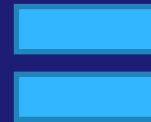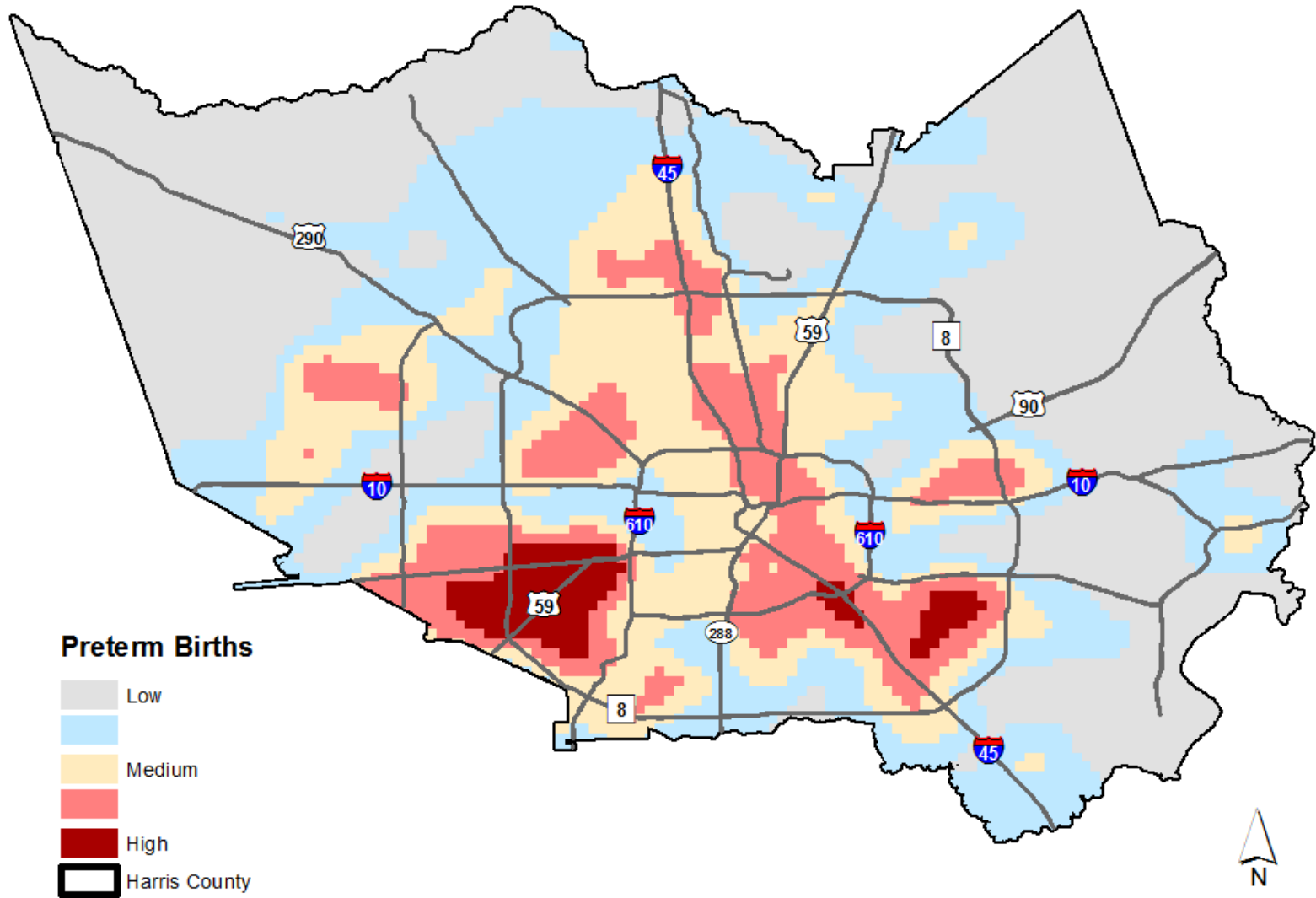Search radius or bandwidth: 1500 meters

KDE Singleton PTB

Z	Z	Z
Z	Z	Z
Z	Z	Z

÷

KDE Singleton Births

Z	Z	Z
Z	Z	Z
Z	Z	Z

=

Ratio of Densities

Rz	Rz	Rz
Rz	Rz	Rz
Rz	Rz	Rz

Single Kernel Density, Number of Singleton Preterm Births
Harris County, Texas, 2008 to 2011

Preterm Births

- Low
- Medium
- High
- Harris County

N

Dual Kernel Density, Percent of Singleton Preterm Births
Harris County, Texas, 2008 to 2011

Preterm Births

- Less than 5.0%
- 5.0 - 9.6%
- 9.7 - 11.4%
- 11.5 - 14.4%
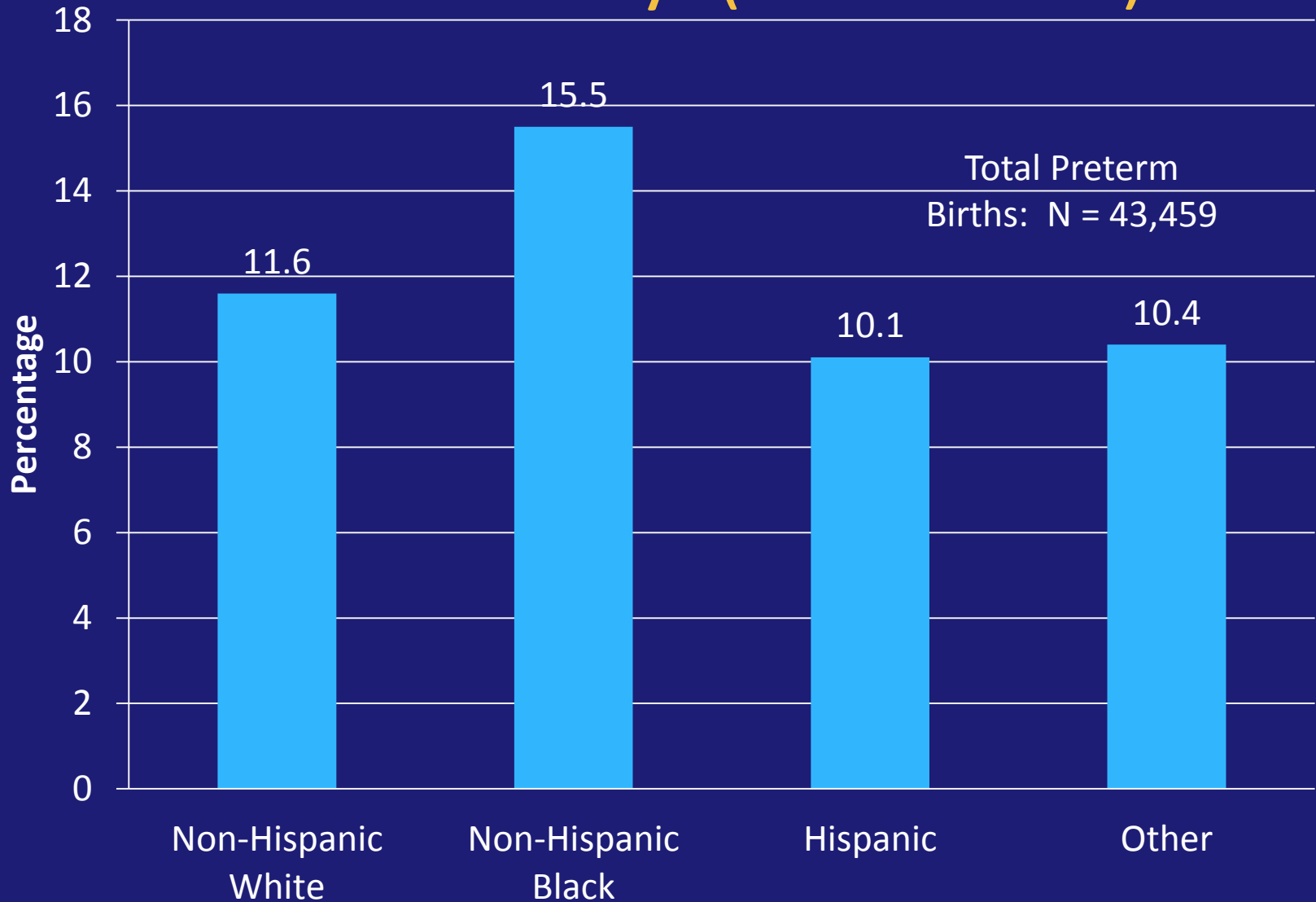- More than 14.4%
- Harris County
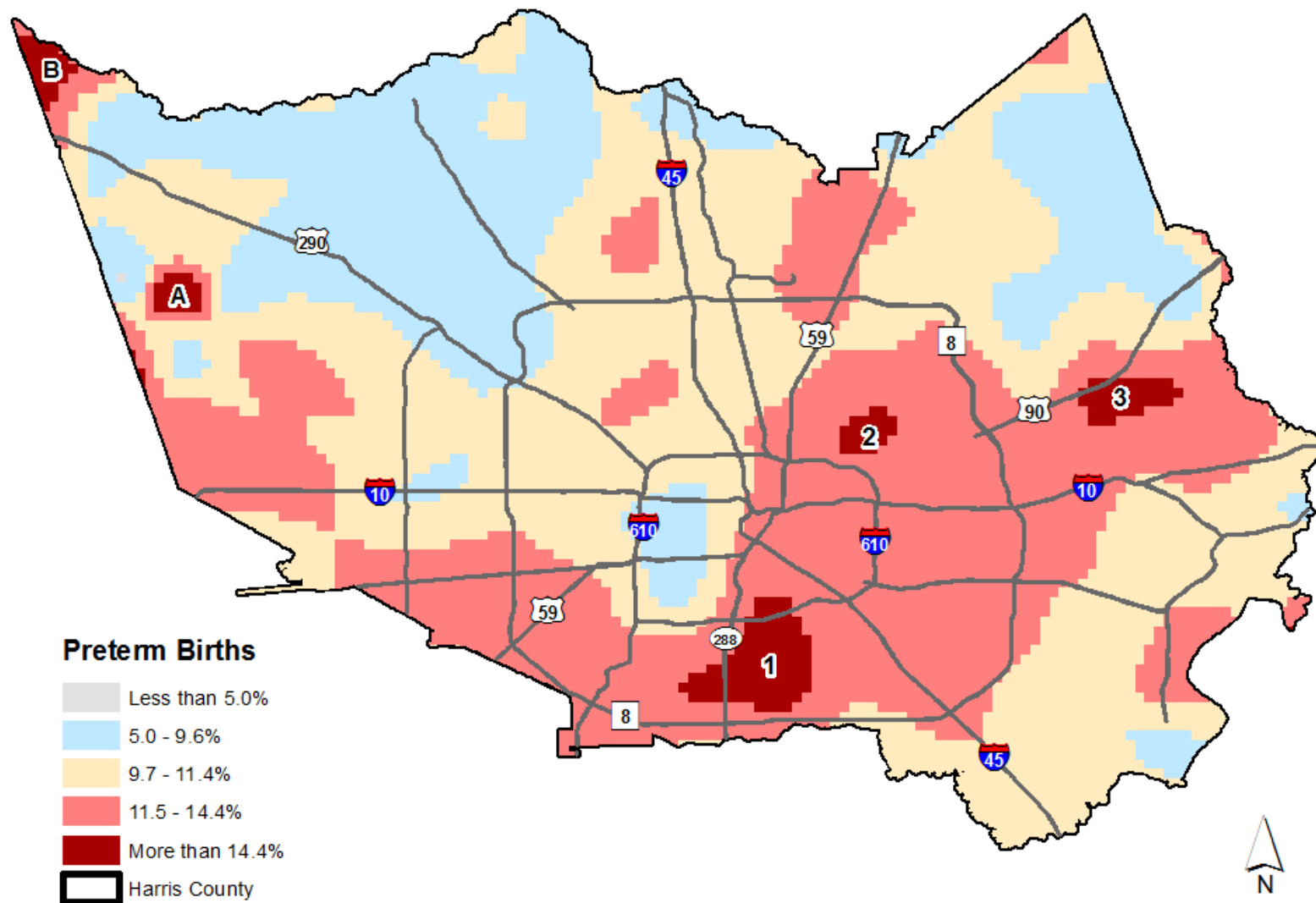
Births in Areas with PTB Greater than 14.4 %

- Area 1 – 7732 total births; 7526 singleton births
- Area 2 – 1867 total births; 1833 singleton births
- Area 3 – 326 total births; 317 singleton births

- Area A – Too few births
- Area B – Too few births within Harris County

PTB by Race/Ethnic Singleton Births Harris County (2008-2011)

Total Preterm Births: N = 43,459

Cases of PTB Across GIS Map Rate Areas

GIS MAP AREA	TOTAL	Non Hispanic White	Non Hispanic Black	Hispanic	Other
≤5%	22	16	1	5	0
5.1-9.6%	6,199	3,710	599	1,225	665
9.7-11.4%	17,358	6,114	2,993	6,910	1,341
11.5-14.4%	17,589	2,853	5,065	8,932	739
≥ 14.5	1,557	255	905	369	28
Unclassified	734	275	149	279	31
TOTALS	**43,459**	**13,223**	**9,712**	**17,720**	**2,804**
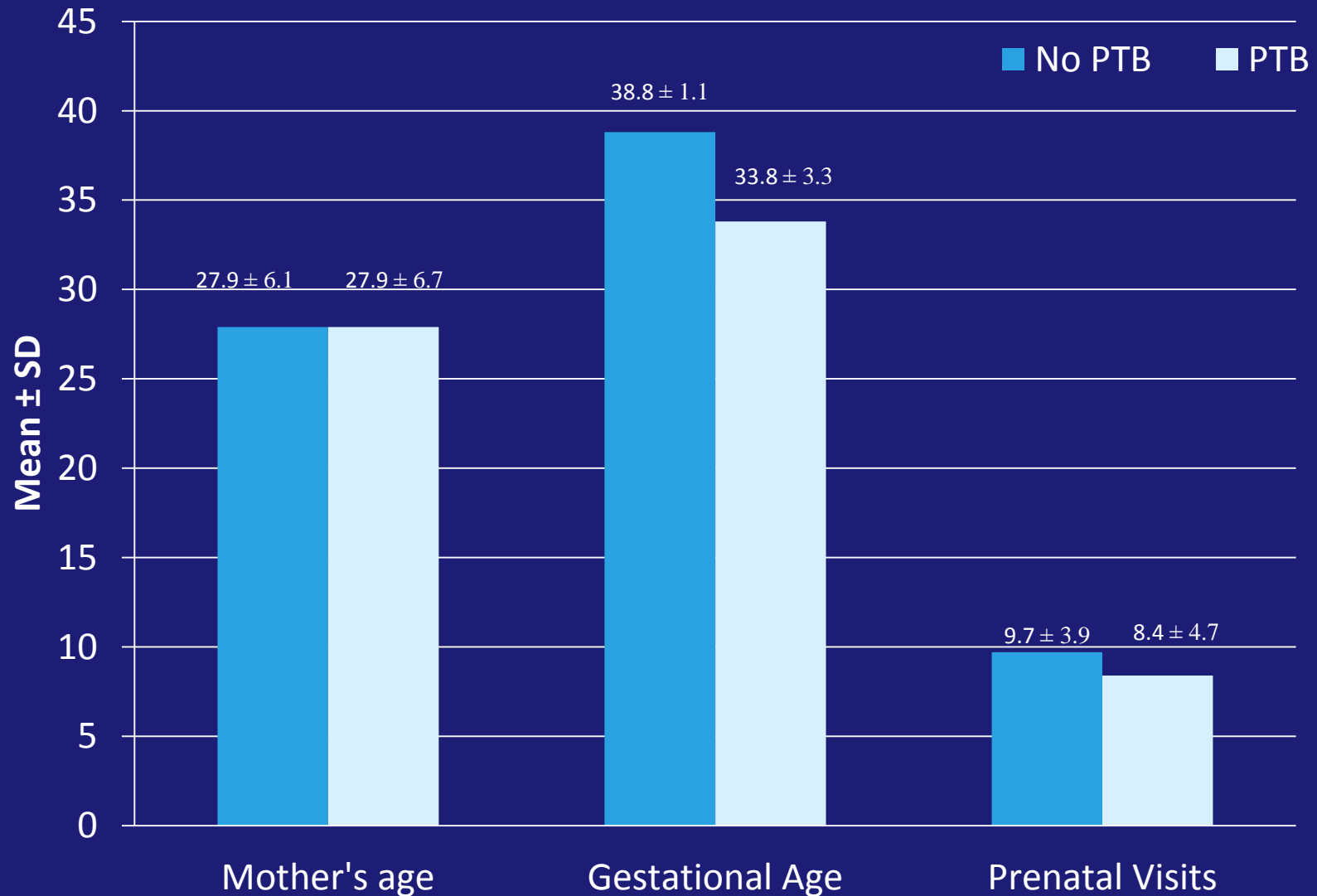
Selected Risk Factors for Preterm Births in Harris County, Texas

	Adjusted OR (95% CI)
Age ≥ 35 years	1.3 (1.27-1.36)
Less than High School Education	0.9 (0.89-0.94)
Pre-pregnancy Obesity	1.1 (1.02-1.08)
Previous Preterm Birth	4.1 (3.94-4.58)
Gestational Diabetes	1.3 (1.13-1.25)
Chronic Diabetes	2.3 (1.72-2.13)
Chronic Hypertension	3.2 (2.94-3.45)
Pregnancy Induced Hypertension	3.8 (3.56-3.86)
Smoking During Pregnancy	1.3 (1.38-1.77)
Racial/Ethnic Group (Referent group, Non-Hispanic White)	
Non-Hispanic Black	1.4 (1.32-1.41)
Hispanic	0.8 (0.85-0.91)
Other	0.8 (0.83-0.93)

Population Attributable Risk % for Harris County and Seven Contiguous Counties (2008-2011)

	Harris County N = 277,946	Non-Harris County N = 101,065
Pre-pregnancy Obesity	3.8	3.8
Previous Preterm Birth	2.6	2.6
Gestational Diabetes	1.7	2.4
Chronic Diabetes	0.9	0.8
Chronic Hypertension	1.9	1.3
Pregnancy Induced Hypertension	8.5	8.8
Smoking Before Pregnancy	0.7	0.5
Smoking During 1st Trimester Pregnancy	0.8	0.1

Prevalence of Preterm Birth Risk Factors Across BMI Categories (%)
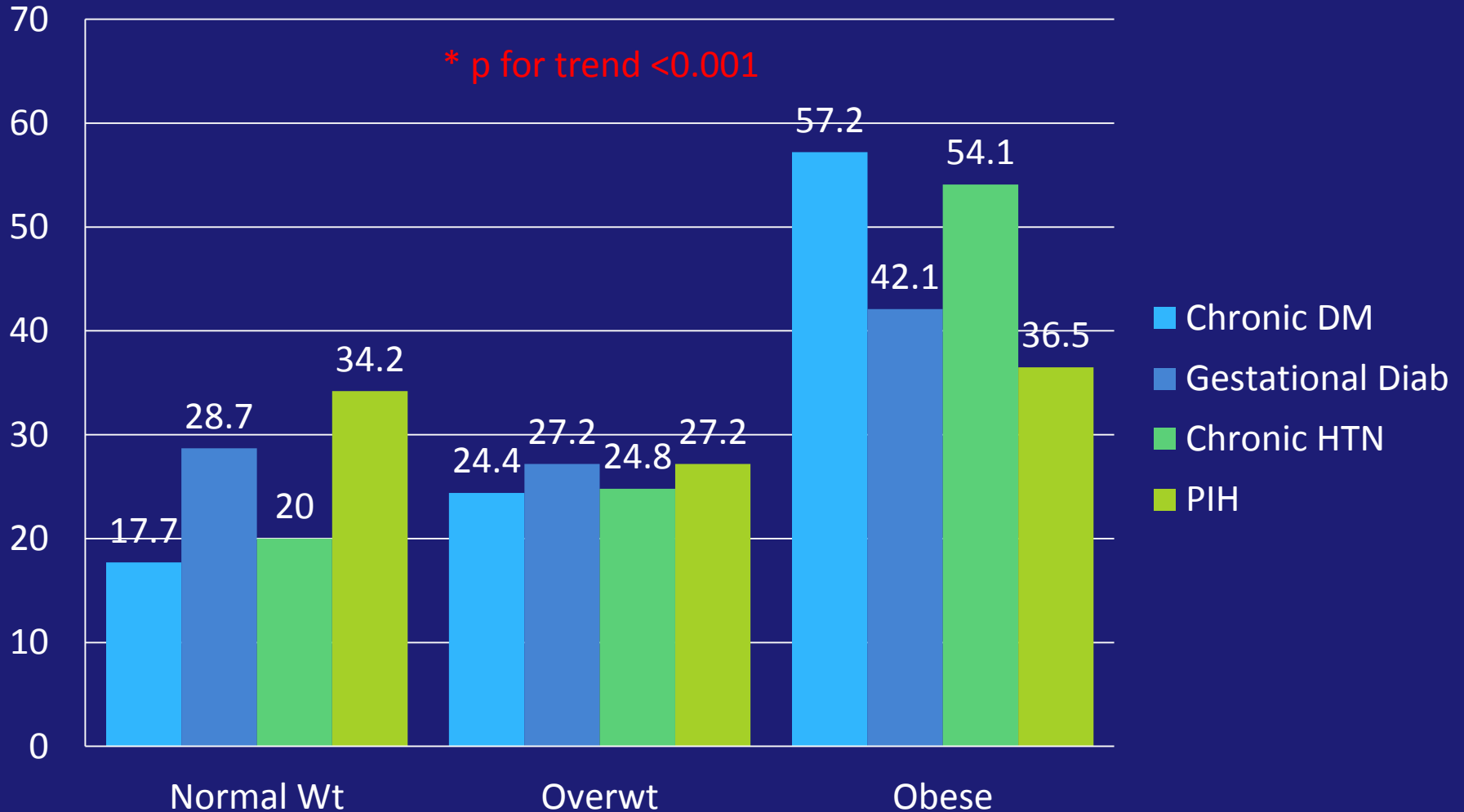
Comparison between Low and High Rate PTB Areas

Variable	GIS Map Area					
	≤5% Mean, SD	5.1-9.6% Mean, SD	9.7-11.4% Mean, SD	11.4-14.4% Mean, SD	≥14.5% Mean, SD	P-value
Mother's Age	27.6±6.8	27.5±6.1	29.7±6.3	28.6±6.7	27.8±6.5	<0.001
# Prenatal Visits	14.4±23.7	12.6±18.7	10.3±12.9	9.9±11.4	10.1±11.9	<0.001
Estimated Gestational Age	34.4±2.6	34.3±3.1	33.8±3.3	33.7±3.3	33.7±3.3	NS
Percent Below Poverty	15.6±5.0	11.9±8.4	10.5±8.6	18.7±13.3	20.1±12.0	<0.001
# Cigarettes Before pregnancy	2.2±5.5	0.7±2.6	0.4±2.6	0.3±1.8	0.3±2.0	<0.001
# Cigarettes 1st trimester	0.7±1.5	0.5±2.2	0.3±1.9	0.2±1.4	0.2±1.9	<0.001

Conclusions

- Using GIS spatial analysis techniques enables the identification of a more precise location of the burden of preterm births. Both in number and in rates.

- Analysis of the areas with different rates of PTB, facilitates the identification of specific preventable risk factors to support targeted strategies to prevent PTB.

References

- Report of the Secretary's Advisory Committee on Infant Mortality (SACIM): Recommendations for Department of Health and Human Services (HHS) Action and Framework for a National Strategy , January 2013
- Institute of Medicine, (2007), Preterm Birth Causes, Consequences and Prevention, National Academies Press, Washington, D.C.

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