# Evaluating the Association of Biological, Social, and Nutritional Status with Adolescent Pregnancy Rates, Physiology, and Birth Outcomes Using Electronic Health Records Data

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## Abstract

**RESEARCH OVERVIEW:** Investigating adolescent and young adult nutritional status, pregnancy rates and birth outcomes require rigorous "Big Data" analysis. The purpose of this study was to determine if disproportionate health burdens are experienced by low income/minority pregnant adolescents and their offspring up to the age of 24 months. The project's community-academic partnership contributed to the creation of a multisite de-identified Electronic Health Records (EHR) database that uses available measures from routine clinical care as a "rapid assay" to explore associations and identify targets for future interventions to address adolescent nutritional and pregnancy outcomes. This partnership has engaged community clinicians, investigators and funders in study design and analysis, as demonstrated by the collaborative development and testing of hypotheses relevant to service delivery. Preliminary findings have found associations between maternal BMI group and birth outcomes similar to those reported in the published literature.

**METHODS/STUDY POPULATION:** We created a community-academic partnership that included New York City Community Health Centers (n=4) and Hospitals (n=4), The Rockefeller University, The Sackler Institute for Nutrition Science and Clinical Directors Network (CDN). We used the Community-Engaged Research Navigation model to establish a multisite de-identified database extracted from electronic health records (EHRs) of female adolescents and young adults aged 12-21 years (Jan 2011 – Dec 2012) and their offspring through 24 months of age. These patients received their primary care between 2011-2015. Clinical data were used to explore possible associations among specific measures. We focused on the preconception, prenatal, postnatal periods, including pediatric visits up to 24 months of age.

**RESULTS:**

**Demographics -** The analysis included all female adolescents (n=122,556) and a subset of pregnant adolescents with offspring data available (n=2,917). Patients were mostly from the Bronx; 42.4% of all females in our population were overweight (21.2%) or obese (21.2%), 31.1% of the females were African American/Black, 45.2% were Hispanic, and 42.4% were ≥ 18 years old. The overall pregnancy rate was 12.7%.

**Blood Pressure Findings -** Abnormal blood pressure (defined as systolic ≥ 120 mm Hg or diastolic ≥ 80 mm Hg) was recorded in 19% underweight, 25% normal weight, 37% overweight, and 51% obese non-pregnant adolescents with similar monotonically increasing rates among pregnant adolescents (data not shown). There was a significant association between abnormal blood pressure and race/ethnicity after controlling for BMI status in non-pregnant (p<0.0001) and pregnant adolescents (p=0.0003). Sustained abnormal blood pressure (defined as 3 or more abnormal blood pressure measurements each at least 1 week apart) was recorded in 3% underweight, 5% normal weight, 11% overweight, and 19% obese non-pregnant adolescents with similar rates among pregnant adolescents (data not shown). There was also a significant association between sustained abnormal blood pressure and race/ethnicity after controlling for BMI status in both cohorts. In multiple logistic regression models with clustering by study site, age, race/ethnicity, BMI status, and pregnancy status were significantly associated with abnormal blood pressure and sustained abnormal blood pressure (p-values < 0.001 for all variables included in the models, results not shown).

**Pregnancy Outcomes -** There was a significant association between maternal BMI status and infants' birth weight, with underweight/normal-weight mothers having more low birth weight (LBW) babies and overweight/obese mothers having more large babies. The odds of having a LBW baby were 0.44 (95% CI: 0.26, 0.74) lower in obese compared to normal-weight adolescent mothers adjusting for age group, race/ethnicity, study site, and visit count. The association between preterm birth before 37 weeks and maternal BMI status was not statistically significant (OR[obese/normal weight] = 0.74, 95% CI: 0.49, 1.13). Preliminary associations are similar to those reported in the published literature.

## Cohort & BMI Group Definition

### BMI Group Definition
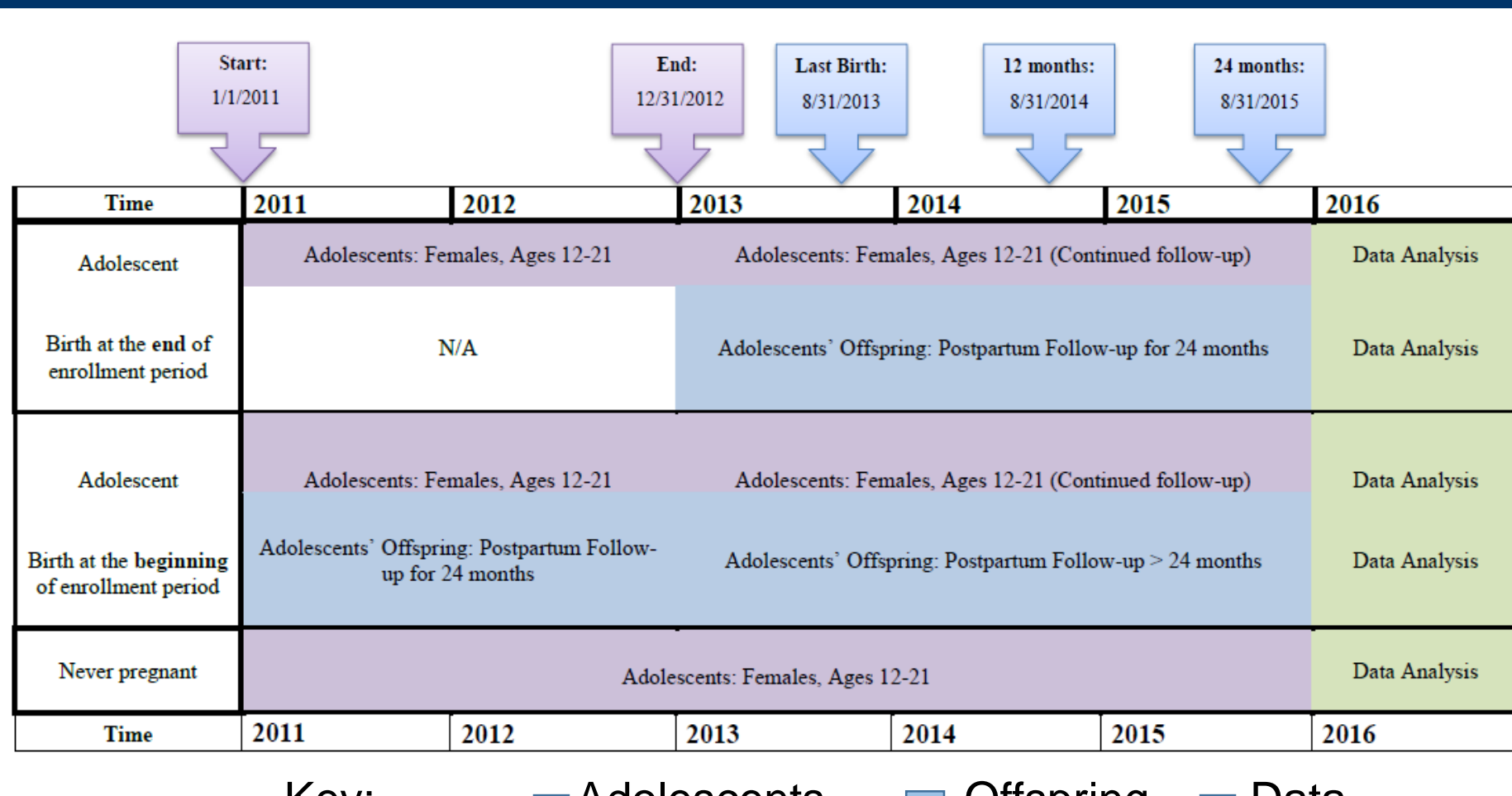
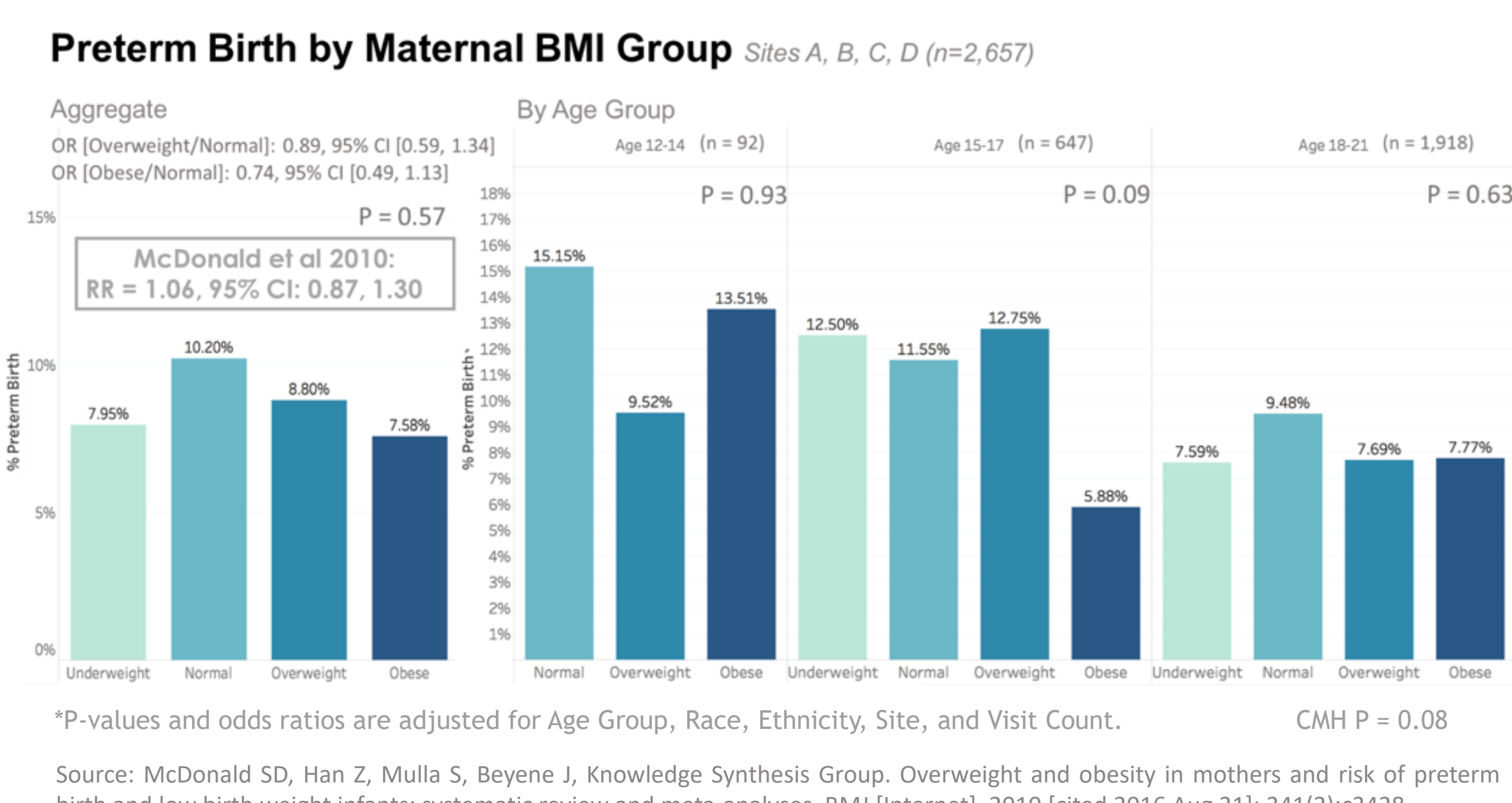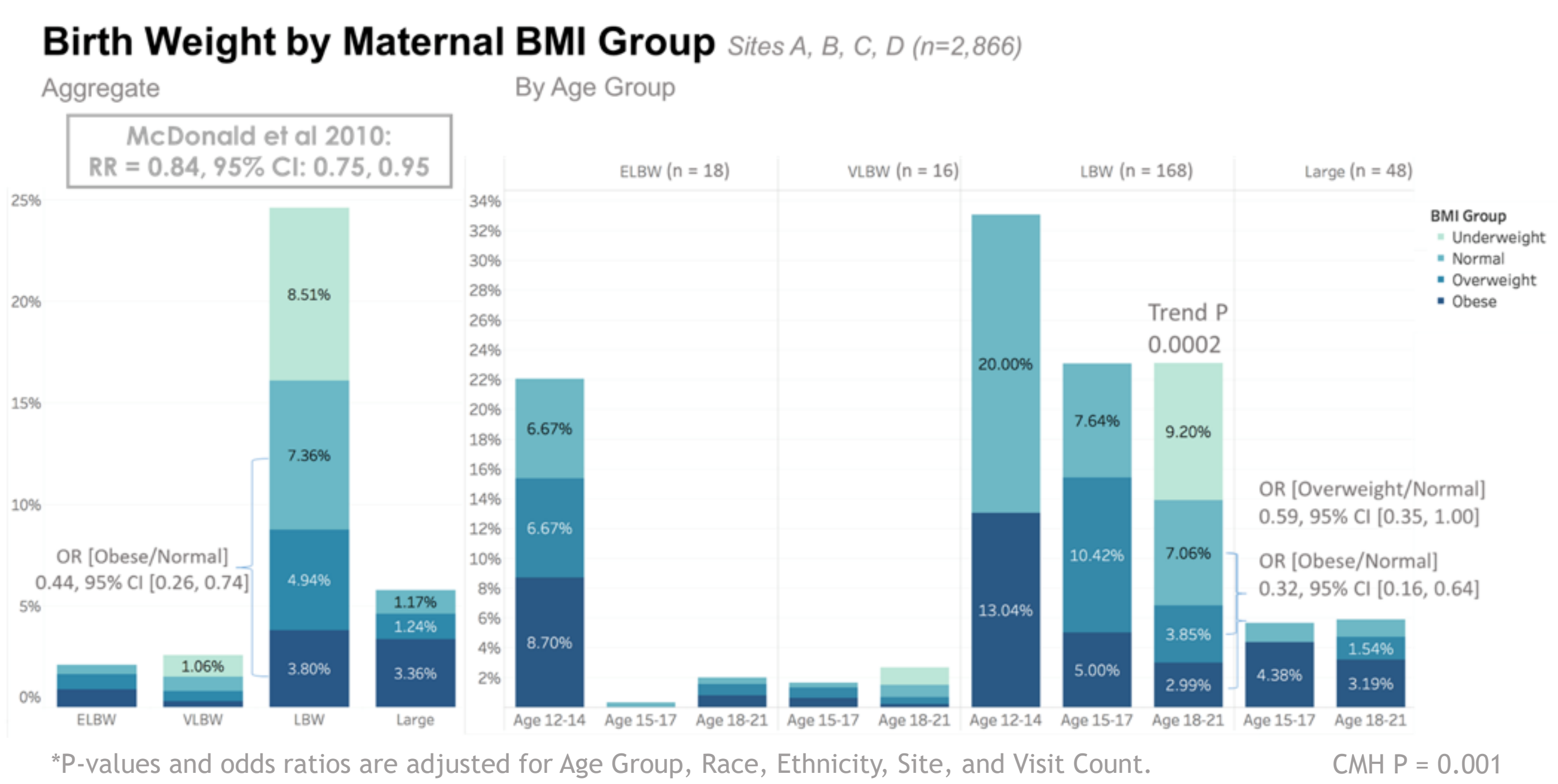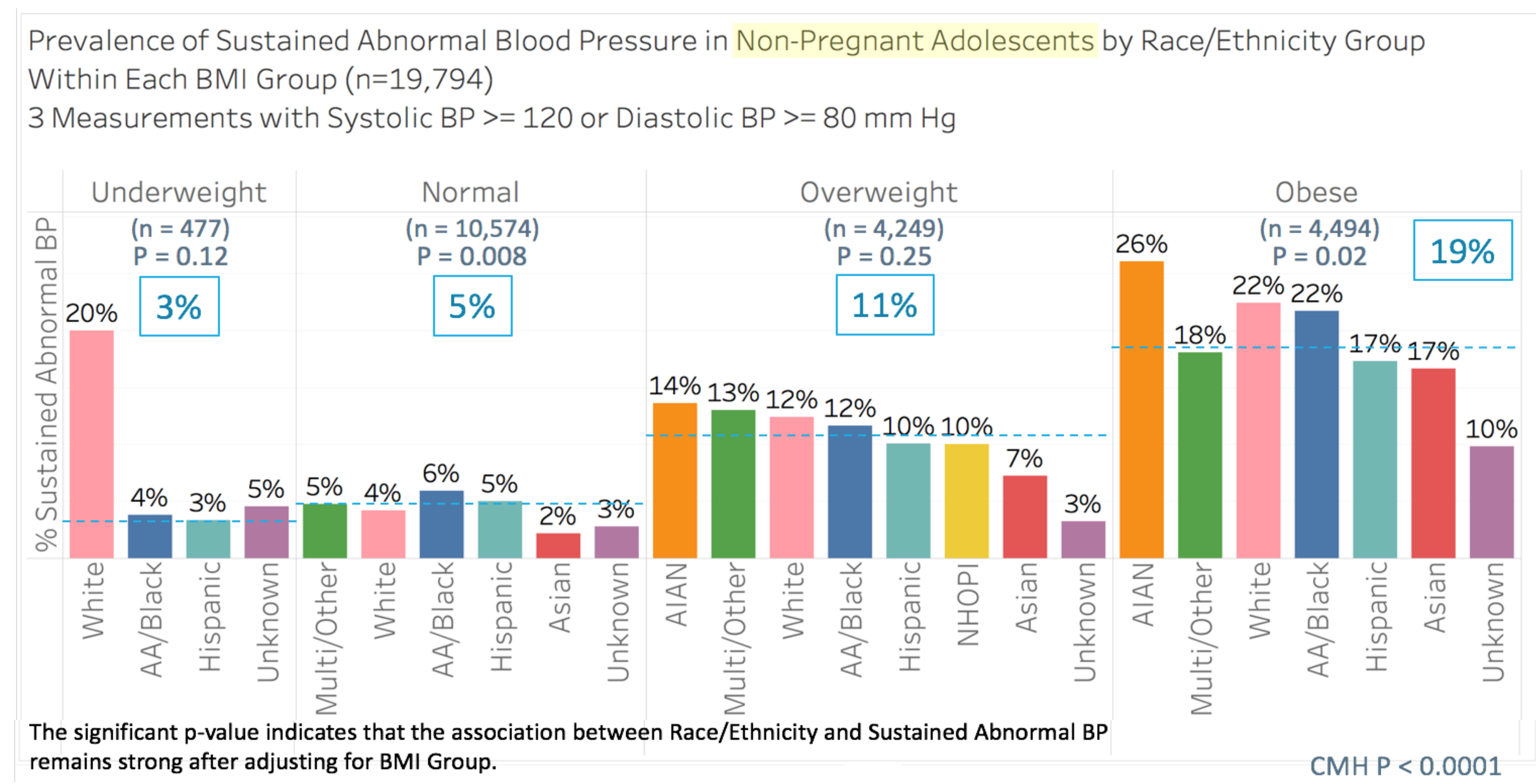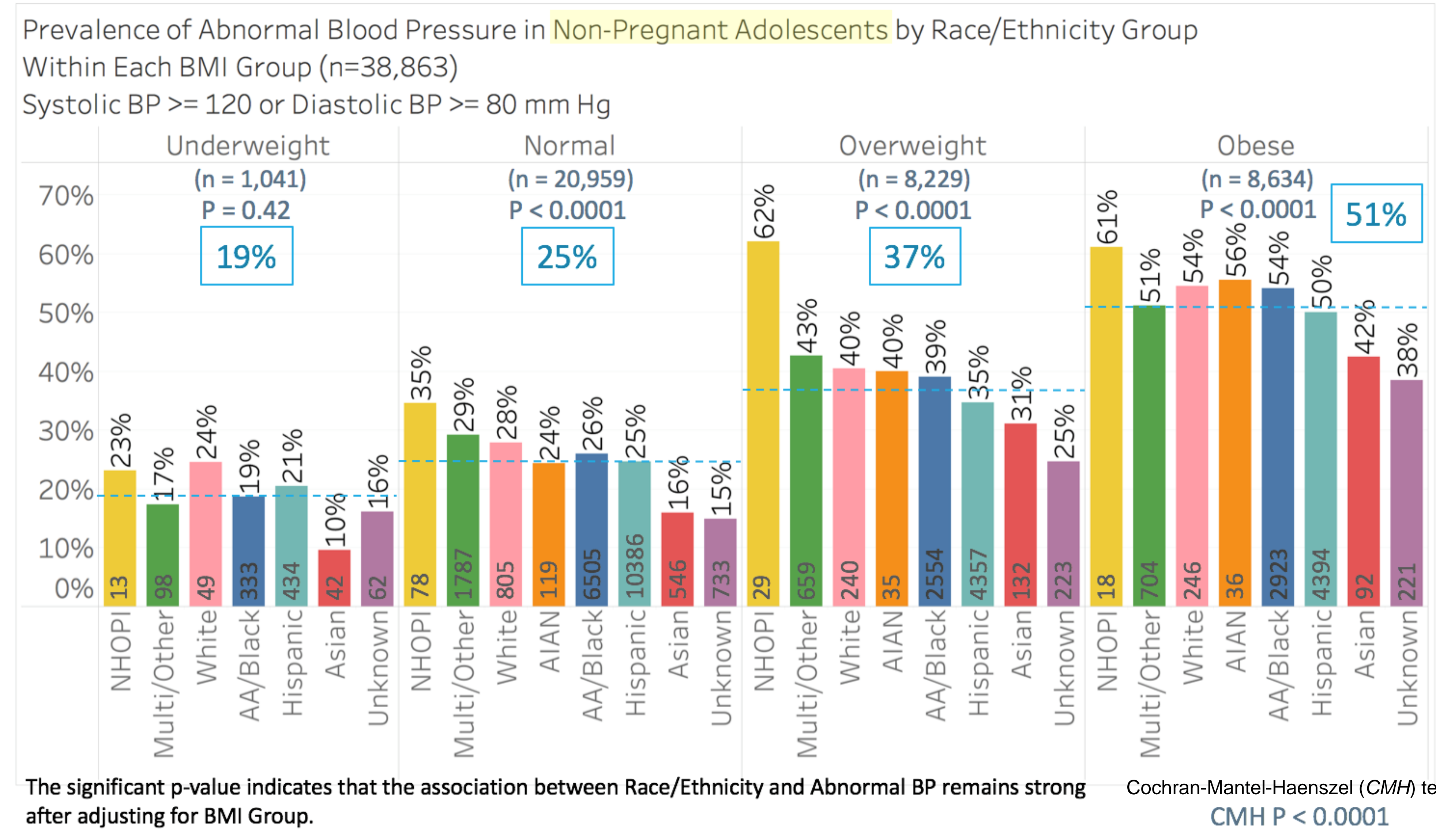| BMI Group | Percentile for Females (Age 12 - 19 years) | BMI for Females (Age ≥20 years) |
|---|---|---|
| Underweight | < 5th Percentile | < 18.5 |
| Normal weight | ≥ 5th to < 85th Percentile | 18.5 – 24.9 |
| Overweight | ≥ 85th to < 95th Percentile | 25.0 – 29.9 |
| Obese | ≥ 95th Percentile | > 30.0 |

## Results

### Demographics

| Characteristic | Underweight (n=1,795) (3.1%) | Normal (n=31,117) (54.4%) | Overweight (n=12,138) (21.2%) | Obese (n=12,133) (21.2%) | Total (n=57,183) (100%) | P-Value |
|---|---|---|---|---|---|---|
| Age (Year) (Mean ± SD) | 17.6 ± 2.5 | 16.7 ± 2.5 | 16.9 ± 2.6 | 16.6 ± 2.6 | 16.7 ± 2.5 | <0.0001 |
| Age ≥ 18 | 59.1% | 41.3% | 45.3% | 40.1% | 42.4% | <0.0001 |
| Race/Ethnicity | | | | | | <0.0001 |
| African American/Black | 29.2% | 30.5% | 30.5% | 33.6% | 31.1% | |
| American Indian/Alaska Native | 1.0% | 0.5% | 0.4% | 0.3% | 0.5% | |
| Asian | 8.3% | 3.2% | 1.6% | 1.0% | 2.5% | |
| Hispanic | 36.0% | 44.0% | 48.6% | 46.1% | 45.2% | |
| Multiracial/Other | 11.9% | 11.2% | 10.6% | 11.0% | 11.1% | |
| Native Hawaiian/Other PI | 0.8% | 0.3% | 0.3% | 0.2% | 0.3% | |
| White | 4.6% | 4.2% | 3.5% | 3.3% | 3.9% | |
| Unknown* | 8.4% | 6.1% | 4.6% | 4.6% | 5.5% | |
| Pregnancy* | 12.8% | 11.6% | 15.6% | 12.8% | 12.7% | <0.0001 |

*Percentage of subjects with reported race
Pregnancy does not contain Site F data

### Blood Pressure

Prevalence of Abnormal Blood Pressure in Non-Pregnant Adolescents by Race/Ethnicity Group Within Each BMI Group (n=38,863)
Systolic BP >= 120 or Diastolic BP >= 80 mm Hg



The significant p-value indicates that the association between Race/Ethnicity and Abnormal BP remains strong after adjusting for BMI Group.

Cochran-Mantel-Haenszel (CMH) test
CMH P < 0.0001

Prevalence of Sustained Abnormal Blood Pressure in Non-Pregnant Adolescents by Race/Ethnicity Group Within Each BMI Group (n=19,794)
3 Measurements with Systolic BP >= 120 or Diastolic BP >= 80 mm Hg



The significant p-value indicates that the association between Race/Ethnicity and Sustained Abnormal BP remains strong after adjusting for BMI Group.

CMH P < 0.0001

### Birth Weight by Maternal BMI Group *Sites A, B, C, D (n=2,866)*



*P-values and odds ratios are adjusted for Age Group, Race, Ethnicity, Site, and Visit Count.
CMH P = 0.001

### Preterm Birth by Maternal BMI Group *Sites A, B, C, D (n=2,657)*



*P-values and odds ratios are adjusted for Age Group, Race, Ethnicity, Site, and Visit Count.
CMH P = 0.08

Source: McDonald SD, Han Z, Mulla S, Beyene J, Knowledge Synthesis Group. Overweight and obesity in mothers and risk of preterm birth and low birth weight infants: systematic review and meta-analyses. BMJ [Internet]. 2010 [cited 2016 Aug 31]; 341(2):c3428.

## Summary

- 31.1% of the females were African American/Black, 45.2% were Hispanic, 42.4% were ≥ 18 years old, 42.4% were overweight or obese and 12.7% were pregnant.
- Age, race/ethnicity, BMI status, and pregnancy status were significantly associated with abnormal blood pressure and sustained abnormal blood pressure in multiple logistic regression models with clustering by study site.
- The association between BMI status of mothers and infants' birth weight was statistically significant, with underweight/normal-weight mothers having more low birth weight (LBW) babies and overweight/obese mothers having more large babies.
- The adjusted odds ratio for LBW was 0.44 (95% CI: 0.26, 0.74) for obese compared to normal-weight mothers, which is similar to the association reported in the McDonald et al. meta-analysis (RR=0.84, 95% CI: 0.75, 0.95).
- There was no significant association between preterm birth before 37 weeks and maternal BMI status, which is similar to the finding reported in the McDonald et al. meta-analysis (RR=1.06, 95% CI: 0.87, 1.30).

## Conclusion

This EHR database uses available measures from routine clinical care as a "rapid assay" to explore potential associations, and may be more useful to detect the presence and direction of associations than the magnitude of effects. Furthermore, this research and learning collaborative is examining strategies to enhance clinical workflow and data quality as well as underlying biological mechanisms. The feasibility of scaling-up these methods facilitates studying similar populations in different Health systems, advancing point-of-care studies of natural history and comparative effectiveness research to identify service gaps, evaluate effective interventions, enhance clinical and data quality, and improve population health outcomes.

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