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Prepregnancy Obesity Trends in 20 States:
Pregnancy Risk Assessment Monitoring System (PRAMS), 2003-2009

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By

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a thesis submitted to the Faculty of the
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Abstract

Prepregnancy Obesity Trends in 20 States:
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By Sarah C. Fisher

Context: Prepregnancy obesity is a well-documented risk factor for a broad range of obstetric complications. Prepregnancy obesity prevalence increased in the US during 1993-2003. Prepregnancy obesity trends have not been assessed since 2003.

Objective: To calculate the trend in prevalence of prepregnancy obesity among women who delivered live births in the United States, by state, age, and race-ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, American Indian/Alaskan Native, Asian/Pacific Islander, other), during 2003-2009.

Methods: We measured prepregnancy obesity (body mass index [BMI] $\geq$30 kg/m^2) trends using Pregnancy Risk Assessment Monitoring System (PRAMS) data from 2003, 2006, and 2009. We included twenty states with data for all three study years in the trend analysis, providing a sample of 90,774 women. We calculated BMI using self-reported height and weight from questionnaires completed 3-6 months after delivery. We used a chi-square test for trend to determine significance of actual and standardized trends, standardized to the age and race-ethnicity distribution of the 2003 study population.

Results: Prepregnancy obesity prevalence increased by an average of +0.5 percentage points per year, from 17.6% in 2003 to 20.7% in 2009 ($p<0.001$). Obesity increased among women ages 20-24 ($p<0.001$), 30-34 ($p=0.001$), and $\geq$35 years ($p=0.003$), and among non-Hispanic white ($p<0.001$), non-Hispanic black ($p=0.02$), Hispanic ($p=0.01$), and other women ($p=0.03$). Overall, the mean rate of increase slowed from +0.6 percentage points per year during 2003-2006 to +0.4 percentage points per year during 2006-2009. Among non-Hispanic black women, however, the mean rate of increase doubled from +0.4 percentage points per year during 2003-2006 to +0.8 percentage points per year during 2006-2009. In 2009, prepregnancy obesity prevalence was highest among women $\geq$35 years (24.0%) and non-Hispanic black women (29.2%) and lowest among women <20 years (11.4%) and Asian/Pacific Islanders (7.2%).

Conclusions: Prepregnancy obesity prevalence continues to increase, and varies by race-ethnicity and maternal age. These findings highlight the need to address obesity as a key component of preconception care, particularly among high-risk groups.

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Chapter 1: Introduction

Introduction and Rationale

Prepregnancy obesity (Body Mass Index [BMI] ≥30 kg/m^2) is associated with an array of negative health outcomes affecting the short- and long-term health of both mother and offspring. Prepregnancy obesity and its co-morbidities also place a financial burden on both the individual and the health system, resulting in higher treatment costs for prenatal, delivery, and postnatal care.[1-3] With nearly one in five pregnant women in the US obese,[4] the physical and financial implications of prepregnancy obesity have the potential for substantial population-level impact.

Current population-based data on prepregnancy obesity in the US are limited. Estimates of obesity prevalence among women of reproductive age (20-39 years) indicate that the trend has plateaued since 1999.[5] Women of reproductive age, however, are not the same population as those who actually become pregnant. In fact, recent data on pregnant women, specifically, suggests that obesity may still be increasing among this subpopulation of women of reproductive age. These data are limited to two studies: one analyzed prepregnancy obesity trends during 1993-2003, but only among nine states[6]; the other was restricted to low-income women during 1999-2008, who may not be representative of the overall population.[7] Both of these studies found statistically significantly increasing trends in prepregnancy obesity. No current data have been published to confirm this trend among the general population of pregnant women in the US.

The US government has identified prepregnancy obesity as a public health policy concern. Healthy People 2020 includes a goal of increasing the proportion of women who enter pregnancy at a healthy weight.[8] However, we cannot measure progress on this objective without further study to better understand trends in prepregnancy BMI among women who become pregnant in the US.

Research Objective

Using data from the Pregnancy Risk Assessment Monitoring System (PRAMS), the purpose of this study was:

- *To estimate the trend in prepregnancy obesity prevalence among women who delivered live births in the US, by state, age, and race-ethnicity, during 2003-2009.*

The following report includes a detailed review of the literature on prepregnancy obesity, its associated health outcomes, and previous research on trends in the US. It also includes our study methodology and results, as well as a discussion of the key public health implications of this research.

Definition of Key Terms

Pregnancy Risk Assessment Monitoring System (PRAMS)

PRAMS is an ongoing population-based surveillance system that collects information on maternal behaviors before, during, and after pregnancy ending in live birth. Using birth certificate records, PRAMS samples live births delivered by state residents within the previous 2-4 months. Respondents generally complete questionnaires 3-6 months following delivery, but are eligible for participation up to 9 months postpartum. Data are collected via self-administered questionnaires that are mailed to respondents' homes, with follow-up for non-response via telephone. Each questionnaire is linked to the respondent's child's birth certificate. Data are weighted to adjust for survey design, non-coverage, and non-response. More detail on PRAMS methodology is available on the PRAMS website (http://www.cdc.gov/prams/methodology).

Body Mass Index (BMI)

BMI is a standard indicator used to describe an individual's amount of body fat. It is calculated using the formula: (weight in kilograms)/(height in meters)^2. According to National Heart, Lung, and Blood Institute guidelines,[9] adult (ages ≥20 years) BMI is categorized according to the following:

- Underweight: BMI <18.5
- Normal weight: BMI 18.5-24.9
- Overweight: BMI 25-29.9
- Obese: BMI ≥30.0

Obesity can be further categorized into classes:

- Class I obese: BMI 30-34.9
- Class II obese: BMI 35-39.9
- Class III obese: BMI ≥40

To account for the fact that children and adolescents (ages <20 years) are still growing, their body fat is categorized using BMI-for-age percentiles, based on the 2000 CDC Growth Charts.[10] We used the following cut-points for adolescent mothers[11]:

- Underweight: <5th BMI-for-age percentile
- Normal-weight: 5th-84.9th BMI-for-age percentile
- Overweight: 85th-94.9th BMI-for-age percentile
- Obese: ≥95th BMI-for-age percentile

It is less standard to categorize adolescents by obesity class. We categorized obesity severity according to the following[12]:

- Moderately obese: 95th-96.9th BMI-for-age percentile
- Severely obese: ≥97th BMI-for-age percentile

Prepregnancy Obesity

Calculated using height and weight data from women's responses to the following PRAMS questions:

- "Just before you got pregnant with your new baby, how much did you weigh?"
- "How tall are you without shoes?"

Race-ethnicity

Women can self-report both race and Hispanic ethnicity on the 2003 US birth certificate. The race categories provided in the PRAMS dataset include: White, Black, American Indian, Chinese, Japanese, Filipino, Hawaiian, Other Non-White, Alaskan Native, Mixed Race. PRAMS also includes a dichotomous variable indicating whether the mother is of Hispanic origin (Mexican/Mexican American/Chicana, Puerto Rican, Cuban, Other), according to the birth certificate. These two categories are not mutually exclusive on the birth certificate. For the purposes of this study, however, we combined race and Hispanic ethnicity into a single race-ethnicity variable. We categorized women who reported Chinese, Japanese, Filipino, or Hawaiian race as Asian/Pacific Islander. We combined American Indian and Alaskan Native into one race category. We combined Other Non-White and Mixed Race into a single "other" race category. We categorized any woman who reported Hispanic ethnicity as such under the new race-ethnicity variable, regardless of any secondary race classification on the birth certificate.

Chapter 2: Comprehensive Review of the Literature

Introduction

Prepregnancy obesity is a public health concern because it is associated with many negative health outcomes for both the mother and the infant. Maternal obesity may also have effects on the long-term health and later BMI of offspring, thus perpetuating the obesity epidemic in the US Despite the evidence of negative health outcomes associated with prepregnancy overweight and obesity, very few population-based data on trends in BMI among pregnant women exist. Furthermore, few successful interventions exist for addressing prepregnancy overweight and obesity.

The following chapter offers a summarized review of the literature on this subject, discussing current evidence of prepregnancy obesity and trends, health outcomes associated with prepregnancy obesity, the financial burden of prepregnancy obesity, interventions aimed at addressing prepregnancy obesity, and next steps.

Measuring Prepregnancy Obesity

Among pregnant women, BMI is measured based on the mother's height and weight prior to becoming pregnant. This is the best indicator for maternal body fat, independent of physiological changes that accompany pregnancy. Prepregnancy BMI thus provides an indicator of preexisting health status. Although height can be reliably measured throughout pregnancy, a woman's weight during pregnancy will be different than it was prior to pregnancy, especially at later gestations. Many women do not receive prenatal care until the second trimester,[13] at which point clinical measurement of prepregnancy weight is no longer possible. Thus, prepregnancy weight data recorded on the US birth certificate, as well as in large surveys such as PRAMS, often rely on maternal self-report of prepregnancy weight.

A systematic review of 64 studies among the general population found that women tend to underestimate self-reported weight compared to clinical measurement, leading to an underestimate of their BMI.[14] The 2001-2006 National Health and Nutrition Examination Survey (NHANES) found that women ages 16-79 significantly underreport their weight, increasingly so as actual BMI increases from normal to overweight and from overweight to obese.[15] Overall, women in this study underestimated their weight by an average of three pounds. In a study looking specifically at prepregnancy weight reporting, Lederman et al found that self-reporting bias was minimal and only significant for underweight women (who overreported weight by 2.4 pounds). When combined with the fact that clinical records were less complete and more difficult to obtain than self-reported data, this study concluded that maternal self-report is an acceptable and practical measure of prepregnancy weight.[16] However, self-reported prepregnancy weight may result in a slight underestimate of BMI.

Existing Evidence of Prepregnancy BMI Trends in the US

Population-based data on trends in prevalence of prepregnancy overweight and obesity in the US are limited. Despite well-documented negative health outcomes associated with prepregnancy overweight and obesity,[17] and evidence of high rates of obesity among women of reproductive age,[5,18] few studies have reported population-based estimates of prepregnancy obesity prevalence or trends in the US.

Data from different sources provide conflicting results on the current trend in obesity prevalence among women of reproductive age. The 2001-2009 Behavioral Risk Factor Surveillance System (BRFSS) data show a significantly increasing trend in prevalence of obesity among women ages

18-44.[18] This study found that obesity increased from 18.3% to 24.7% over this time period, a change that remained significant after adjusting for age, race-ethnicity, education, health care coverage, and individual state of residence. For a similar time period, however, data from NHANES show no significant trend in obesity prevalence among women ages 20-39 between 1999 and 2008.[5] Nevertheless, this study estimated that obesity prevalence among this age group in 2007/2008 had stagnated around 34%, which remains very high. The differences in results from these two data sources may be due, in part, to differences in data collection methodology—BRFSS data is self-reported via phone interviews, whereas NHANES height and weight data are measured by survey administration staff and may be more accurate. Furthermore, BMI varies widely by geography,[4] so that differing geographic distribution of respondents to these two surveys may affect results. Additionally, the BRFSS sample size (n=327,917) is much larger than NHANES (n=877), providing greater power to detect changes in prevalence over time.

Although estimates of obesity among women of reproductive age may be similar to those among pregnant women, it is important to analyze trends in this group specifically. Women of reproductive age represent a broad population of women who are planning on becoming pregnant, who have already had children, who will never have children, and who are finished having children; women who are currently pregnant are a very specific subset of this population. Given the risks associated specifically with obesity during pregnancy, data on prevalence and patterns of obesity among this specific group of women is critical in order to identify high-risk groups and inform targeted interventions.

The only known population-based analysis of obesity among pregnant women in the US utilized PRAMS data to investigate changes in prevalence of prepregnancy obesity (BMI $\geq$ 29.0) between 1993 and 2003.[6] This study found that prepregnancy obesity (BMI$\geq$29.0) increased by 69.3% overall during those years, from 13.0% to 22.0%. The analysis included nine states, each of which experienced a statistically significant increase in prepregnancy obesity over the time period ($p<0.000$). In a sub-analysis, the same authors also found that prepregnancy BMI varied significantly by demographic and socioeconomic characteristics. Data from 2002-2003 indicate an increased risk of both prepregnancy overweight and obesity among women who are ≥30 years, non-Hispanic black, parous, or enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), compared to women who were <20 years, white, nulliparous, or not enrolled in WIC, respectively.[6]

Building on these results, the only other study of prepregnancy obesity trends in the US focused specifically on low-income women participating in WIC. Using data from the Pregnancy Nutrition Surveillance System (PNSS), this study found that prepregnancy obesity (BMI ≥ 30) increased from 24.8% among WIC-recipients in 1999 to 28.3% in 2008, when standardized by age and race-ethnicity.[7] This trend was statistically significant at the $\alpha=0.05$ level.

Given that prepregnancy obesity prevalence varies substantially by geography[4] and by socioeconomic status,[6] the above findings should all be re-evaluated in order to draw conclusions about the current status of the general pregnant population in the US

Health Outcomes Associated with Prepregnancy BMI

Many short- and long-term maternal and infant health outcomes are associated with high prepregnancy BMI (Table 2.1). These include increases in gestational diabetes mellitus (GDM), hypertensive disorders, cesarean delivery, suboptimal breastfeeding practices, miscarriage, stillbirth, fetal macrosomia, preterm birth, and birth defects.[17,19-21]

Gestational Diabetes Mellitus

GDM, defined as glucose intolerance that is first identified during pregnancy, affects 2-10% of pregnancies in the US.[22] Although in most women the condition subsides following pregnancy, the CDC estimates that 5-10% of women with GDM will be diagnosed with type 2 diabetes postpartum, and that women with GDM have as high as a 60% chance of developing type 2 diabetes in the 10-20 years following pregnancy.[22]

The increased risk of GDM among overweight and obese women, compared to normal-weight and underweight women, is well documented. Two recent meta-analyses including 20 and 70 studies, respectively, found consistently increased odds of GDM with increased prepregnancy BMI.[23,24] Chu et al found that the odds ratios (OR) of developing GDM were 2.14 (95% CI 1.82-2.53), 3.56 (95% CI 3.05-4.21), and 8.56 (95% CI 5.07-16.04) among overweight, obese, and severely obese pregnant women, respectively, compared to normal-weight pregnant women.[23] Torloni et al found increasingly higher odds of GDM among women with higher prepregnancy BMI as well, although with a slightly smaller magnitude of effect.[24] This analysis found that the odds ratios of developing GDM were 1.97 (95% CI 1.77-2.19), 3.01 (95% CI 2.34-3.87), and 5.55 (95% CI 4.27-7.21) among overweight, moderately obese, and severely obese pregnant women compared to normal-weight pregnant women; for every one point increase in BMI, the risk of GDM increased by 0.92% (95% CI 0.73-1.10).

Hypertensive Disorders

Pregnancy-associated hypertensive disorders include chronic hypertension, gestational hypertension, preeclampsia, and eclampsia. These disorders affect approximately 5-10% of pregnancies globally; preeclampsia, specifically, affects around 3% of pregnancies in the US.[25] In a recent review of maternal mortality worldwide, the World Health Organization found that hypertensive disorders are the single leading cause of maternal death in developed countries, accounting for more than 16% of deaths.[26] Preeclampsia is associated with renal failure, pulmonary edema, and placental abruption in the mother, as well as stillbirth, preterm delivery, low birthweight, and neonatal mortality.[25]

A number of studies have linked preeclampsia to maternal obesity, with results consistently indicating a positive association between the two. A systematic review of 13 studies found that prevalence of preeclampsia increased with increasing BMI.[27] In eight of the studies analyzed, the adjusted odds ratios of preeclampsia among overweight/obese women compared to non-overweight women ranged from 2.1 to 5.2, each of which was statistically significant.[27]

Cesarean Delivery

Numerous studies have found that increasing BMI is associated with progressively higher odds of cesarean delivery. Compounding this elevated risk are increased operative and postoperative complications associated with obesity. These include hemorrhage, operative time exceeding two hours, increased odds of infection, as well as anesthetic challenges.[17]

A meta-analysis of 11 studies by Poobalan et al indicates that the odds ratios for cesarean delivery among overweight, obese, and severely obese women, compared to normal-weight women, were: 1.53 (1.48, 1.58), 2.26 (2.04, 2.51), and 3.38 (2.49, 4.57), respectively.[28] This analysis also found that overweight and obese women also had higher odds of emergency cesarean deliveries, specifically: OR 1.64 (95% CI 1.55-1.73) and 2.23 (95% CI 2.07-2.42), respectively. Similarly, Chu et al’s meta-analysis of 33 studies found that the unadjusted odds ratios of cesarean delivery among overweight, obese, and severely obese women were 1.46 (95% CI 1.34–1.60), 2.05 (95% CI 1.86–2.27) and 2.89 (95% CI 2.28–3.79), respectively, compared to normal-weight women.[29]

Suboptimal Breastfeeding Practices

Current evidence suggests that obesity is associated with lack of breastfeeding initiation and shorter breastfeeding duration.[21] Exclusive breastfeeding for the first six months of life has been proven to have protective effects against gastrointestinal and respiratory infection,[30] and may have long-term benefits in reducing later obesity and, potentially, associated chronic disease.[31]

In an analysis of the PNSS and Pediatric Nutrition Surveillance System (PedNSS) for 1996-1998, overweight and obese women had significantly higher odds of failing to initiate breastfeeding than their normal-weight counterparts.[32] This same study also found that women with an obese prepregnancy BMI breastfed for 1.7 fewer weeks than women with a prepregnancy BMI in the normal range ($p<0.001$). A study of postpartum women in Australia also found higher odds of breastfeeding for less than 2 months, less than 4 months, and less than 6 months among overweight and obese women than among normal-weight women (Overweight: AOR 1.52, 95% CI 1.11- 2.09; 1.62, 95% CI 1.20-2.18; 1.53, 95% CI 1.13-2.07, respectively. Obese: AOR 1.89, 95% CI 1.45-2.47; 1.95, 95% CI 1.51-2.51; 1.76, 95% CI 1.35-2.28, respectively).[33]

Miscarriage

Maternal BMI also appears to be associated with miscarriage, in both spontaneous and assisted pregnancies. Miscarriage, or spontaneous abortion, refers to the expulsion of a fetus before reaching a gestational age at which it would be able to survive outside of the uterus.[34] A meta-analysis of only naturally occurring pregnancies found that overweight and obese women had increased odds of experiencing at least one miscarriage (OR 1.11, 95% CI 1.00-1.24; OR 1.31, 95% CI 1.18-1.46, respectively).[35] In an analysis that included assisted conception, Metwally et al also found significantly increased odds of miscarriage among overweight and obese women combined (1.67, 95% CI 1.25-2.25).[36] Among women with assisted conception, specifically, odds of miscarriage were increased among overweight/obese women who underwent ovulation induction and oocyte donation (OR 5.11, 95% CI 1.76-14.83; OR 1.52, 95% CI 1.10-2.09, respectively), however not among overweight/obese women who underwent in vitro fertilization-intracytoplasmic sperm injection (IVF-ICBI) (OR 1.52, 95% CI 0.88-2.61).[36] Obesity may also be associated with recurrent early miscarriage (defined as >3 successive miscarriages at <12 weeks gestation), with increased odds among obese women as compared to normal-weight women (OR 3.5, 95% CI 1.03-12.01).[37]

Stillbirth

Stillbirth is defined as a fetal death before delivery, but after a gestational age at which the fetus could survive outside the uterus.[34] Definitions vary by country,[34] but in the US stillbirths are defined as a fetal death at ≥20 weeks gestation.[38] Although the causes of roughly half of stillbirths remain unknown, prepregnancy overweight and obesity is a known risk factor for stillbirths throughout the world.[39] Studies have found odds ratios of stillbirths ranging from 1.2 (1.09-1.38)[40] to 1.47 (1.08-1.94)[39] among overweight women compared to normal-weight women, and from 1.6 (1.35-1.95)[40] to 2.07 (1.59-2.74)[39] among obese women compared to normal-weight women. One meta-analysis calculated that this translates to a population-attributable risk of 8-18% across five countries (Australia, Canada, US, UK, and Netherlands), resulting in more than 8,000 excess stillbirths.[40] This made prepregnancy obesity the “highest ranking modifiable risk factor” for stillbirth in that analysis.

Fetal Macrosomia

Fetal macrosomia, defined either as birthweight >4,500 grams or >4,000 grams, can be dangerous for both mother and child. High birthweight can lead to delivery complications, including shoulder dystocia, plexus injuries, and cesarean delivery.[41] The relationship between obesity and macrosomia has been well documented. Available data consistently indicate a positive association between BMI and macrosomia. A selection of recent studies found adjusted odds ratios of macrosomia ranging from 2.0 among obese women compared to normal-weight women (BMI 30-34.9) to 3.55 among severely obese women (BMI >40).[42-44] Data from the Norwegian Mother and Child Cohort Study indicate that for every one unit increase in prepregnancy BMI there is a 25.9g increase in birthweight.[45] A study in Denmark calculated the population attributable fraction (PAF) of large for gestational age infants due to excessive maternal weight (BMI>25) to be 13.7%, with considerable variation between ethnic groups.[46]

Preterm Birth

Preterm birth is a leading cause of infant mortality, and is associated with respiratory problems, neurologic disabilities, and developmental delays among children.[47] The risk of preterm birth associated with maternal BMI has been debated in the literature,[17] highlighting the importance of distinguishing spontaneous and medically-indicated preterm birth. A recent meta-analysis of 84 studies found that the overall risk of preterm birth (defined as <37 weeks) was similar among overweight and obese women compared to normal-weight women (relative risk [RR] 1.06, 95% CI 0.87-1.30). However, the risk of induced preterm birth was significantly higher among overweight and obese women than among normal-weight women (RR 1.30, 95% CI 1.23-1.37). The authors found that this association increased with increasing BMI; the relative risk of induced preterm birth among overweight, obese, and very obese women was 1.15 (95% CI 1.04-1.27), 1.56 (95% CI 1.42-1.71), and 1.71 (95% CI 1.50-1.94), respectively.[48]

A separate meta-analysis of 39 studies also found that degree of obesity is associated with preterm birth. In this study, pre-obese and class I obese women (BMI 30-34.9) did not have significantly different risk of preterm birth (<37 weeks) than normal-weight women (including both spontaneous and medically-induced preterm deliveries).[19] Women categorized as class II (BMI 35-39.9) and class III obese (BMI ≥40), however, did have significantly increased risk of preterm birth overall (RR 1.33, 95% CI 1.12-1.57 and RR 1.83, 95% CI 1.62-2.07). These associations either reversed or became insignificant when restricted to spontaneous preterm births only.

Evidence also suggests that the association of obesity with preterm birth varies with the degree of prematurity. McDonald et al's meta-analysis found that overweight/obesity was significantly associated with increased risk of preterm births <33 weeks, regardless of whether spontaneous or induced (RR 1.26, 95% CI 1.14-1.39); this risk increased with increasing BMI.[48] Torloni et al also found that obesity class I, II, and III were each associated with increasing risk of preterm birth <32 weeks (AOR 1.43, 95% CI 1.20-1.70; 1.96, 95% CI 1.66-2.31; 2.27, 95% CI 1.76-2.94, respectively).[19] A recent study in Denmark estimated that the PAF due to overweight/obesity was 5.7% for preterm birth (<37 weeks) and 19.7% for very preterm birth (<32 weeks).[46]

Birth Defects

Investigators have also linked prepregnancy obesity with a broad range of birth defects, including spina bifida, anencephaly, heart defects, cleft lip and palate, and limb deficiencies, with varying results.[20,49,50] The evidence points most consistently to a positive association between BMI and neural tube defects (NTD).[20,49] A recent meta-analysis found that the unadjusted ORs for an NTD-affected pregnancy among overweight (12 studies), obese (11 studies), and severely obese (5 studies) women were: 1.22 (95% CI 0.99-1.49), 1.70 (95% CI 1.34-2.15), and 3.11 (95% CI 1.75-5.46), respectively, compared with normal-weight women.[51] A second meta-analysis of 9 studies also found that both overweight and obese women had increased odds of an NTD-affected pregnancy: OR 1.20 (95% CI 1.04-1.38) and 1.87 (95% CI 1.62-2.15), respectively.[50]

Congenital heart defects have also been linked to maternal overweight and obesity. Stothard et al's meta-analysis notes a statistically significant relationship between both obesity and heart defects (OR 1.30, 95% CI 1.12-1.51) and overweight and heart defects (OR, 1.17; 95% CI, 1.03-

1.34) when compared to normal-weight women.[50] These results are consistent with a more recent study not included in that analysis, which found that the odds ratios for all heart defects combined were 1.16 (95% CI 1.05-1.29), 1.15 (95% CI 1.00-1.32), and 1.31 (95% CI 1.11-1.56) for overweight, moderately obese (BMI 30.0-34.9), and severely obese (BMI ≥ 35.0) women, respectively.[52]

Long-term Effects

An emerging theory, based on the developmental origins of disease hypothesis, is that adult BMI is influenced in utero by the mother's BMI. There is some, albeit limited, evidence for this theory, suggesting that offspring born to obese mothers may be at higher risk of later overweight and obesity. In a study of more than 8,000 children receiving WIC in Ohio, prevalence of obesity among 2-, 3-, and 4-year olds was significantly higher among women with higher prepregnancy BMI ($p<0.001$). The adjusted odds ratios of obesity among children born to women with prepregnancy BMI of 30-39.9 were 2.28 (95% CI 1.84-2.83), 3.06 (95% CI 2.49-3.76), and 3.07 (95% CI 2.48-3.79) among 2-, 3-, and 4-year olds, respectively. Adjusted ORs for obesity among 2-, 3-, and 4-year old children born to severely obese women (BMI≥40) were 3.05 (95% CI 2.22-4.18), 3.82 (95% CI 2.8-5.19), and 4.31 (95% CI 3.17-5.87), respectively.[53] A separate study of Swedish men found that prepregnancy BMI was one of the strongest factors associated with obesity at age 18 (along with smoking during pregnancy).[54] Similarly, Gale et al found that, in a cohort of 216 9-year old children in the UK, for every 1 SD increase in prepregnancy BMI, boys' fat mass index increased by 0.26 ($p<0.05$) and girls' fat mass index increased by 0.42 ($p<0.001$).[55]

However, a common concern in these and similar studies is unmeasured confounding.[56,57] In particular, a persistent challenge is how to adequately control for common lifestyle that may cause both mother and child to be obese, in order to estimate the independent effect of prepregnancy BMI on offspring obesity. Nevertheless, there does seem to be an intergenerational effect that should be considered when developing obesity prevention interventions. Addressing prepregnancy obesity may be a critical link in breaking the obesity cycle in the US.

Notably, maternal obesity has a number of potential secondary effects on the long-term health of offspring, due to obstetric complications resulting from obesity. For instance, offspring of GDM-affected pregnancies appear be at an increased risk of developing type 2 diabetes later in life.[58,59] Data from the Northwestern University Diabetes in Pregnancy Center indicate that offspring of GDM-affected pregnancies have almost five times higher risk of insulin resistance at 14-17 years, compared to controls (RR 4.7, 95% CI 1.7, 12.9).[60] Preterm birth is also associated with increased risk of death and disability, especially at earlier gestational ages. Disabilities include hearing loss and cognitive malfunction.[61] Finally, as mentioned above, prepregnancy overweight and obesity are associated with lack of appropriate breastfeeding, which may also increase risk of obesity among offspring later in life.[31]

Financial Burden of Prepregnancy Overweight and Obesity

Obesity during pregnancy is also associated with considerable financial burden. The obstetric complications described above have cost implications at both the individual and institutional levels. For instance, additional costs may be associated with adverse health outcomes such as increased likelihood of infection, cesarean delivery, and very preterm birth among overweight and obese women.[3] Although unexplained, researchers have also observed that medication use increases with BMI among pregnant women.[1]

Extra costs associated with obesity during pregnancy have been assessed primarily in terms of length of hospital stay. A small study in France found that women with prepregnancy BMI >29 stayed in the hospital for an average of 4.4 days longer than normal-weight women (BMI 18-25).[2] A larger study of US women found a smaller, but still statistically significant, difference in the average length of hospital stay between BMI groups. In that study, increasing maternal BMI was associated with increasing length of stay, such that normal-weight women stayed in the hospital for an average of 3.6 days, whereas overweight women stayed an average of 3.7 days, moderately obese women (BMI 30-34.9) stayed an average of 4.0 days, very obese women (BMI 35-39.9) stayed an average of 4.1 days, and severely obese women (BMI≥40) stayed an average of 4.4 days. Length of stay for each overweight and obese BMI group was significantly more than that of women in the normal-weight group.[1]

Efforts to Prevent and Address Prepregnancy Overweight and Obesity

Quality preconception care is critical to addressing prepregnancy overweight and obesity. Current recommendations list obesity as one of 14 major risk factors for adverse pregnancy outcomes and an indication for preconception counseling.[62] Clinical guidelines for preconception care provision include screening for and attention to nutrition and weight management.[62] And yet the objective of increasing preconception care was dropped from Healthy People 2010 due to lack of measurement.[62] Hopefully, with the inclusion of the Healthy People 2020 objective to increase the proportion of women entering pregnancy at a healthy weight by 10%, policymakers and health care providers will be encouraged to renew their focus on preconception care for women.[8]

However, barriers remain to accessing preconception care, including lack of insurance coverage. An estimated 20% of women ages 18-64 are uninsured, more than half of whom report not having a regular doctor and neglecting to access needed care due to cost.[63] Furthermore, regardless of insurance coverage status, 16% of women of reproductive age do not regularly visit a health care provider.[64] This indicates missed opportunities to screen for modifiable risk factors for adverse pregnancy outcomes, such as overweight and obesity.

Another noted challenge is how to motivate young women who are not intending to become pregnant to seriously consider preconception health interventions.[65] However, with an estimated 49% of pregnancies in the US unintended, and more than half of those carried to term, a substantial proportion of women do not have the opportunity to lose weight specifically in preparation for a planned pregnancy.[66] Thus, universal standard preconception care—that is delivered in a lifecourse-appropriate manner as a component of preventive and reproductive health care—may be the only way to address obesity among women not planning to become pregnant.

To reach those women who are planning to become pregnant, one obvious target population is women who are undergoing treatment for infertility. One intervention among this population in Australia offered weekly group sessions that included exercise classes and seminars on diet and physical activity. This program resulted in weight loss and increased fertility among participants, although most remained overweight or obese.[67] Furthermore, not all overweight and obese women seek fertility assistance, so would not be captured in studies or interventions that are restricted to this population.

Typically, interventions have been aimed at women who are already pregnant or are postpartum. During pregnancy, the focus is on appropriate weight gain, whereas postpartum interventions focus on weight loss and maintenance. Evidence suggests that women who gain more than the recommended amount of weight during pregnancy are more likely to experience postpartum weight retention and enter their next pregnancy overweight or obese.[68] Thus, approaches focusing on gestational weight gain and postpartum weight loss may also have an effect on subsequent prepregnancy BMI. A meta-analysis of gestational weight gain programs found that interventions that promote physical activity and provide dietary counseling, especially when combined with weight monitoring, are successful in reducing gestational weight gain.[69] Similarly, successful postpartum weight loss programs tend to be individually tailored and include a combination of both diet and exercise components.[70]

However, with as many as 34% of women of reproductive age obese,[5] we need to bring successful lifestyle intervention models to scale in order to reduce obesity at the population level, instead of within relatively small, localized programs. A number of obesity reduction programs have been put in place at the state level, primarily focusing on childhood obesity, breastfeeding, and improving access to healthy food options for low-income families.[71] There is a distinct lack of national and state level policies or programs specifically targeting obesity prevention and reduction among women of reproductive age, despite the demonstrated evidence of obesity among this group and associated negative health outcomes.

Next Steps

To our knowledge, the only population-based trend analysis of prepregnancy BMI in the US assessed data from 1993-2003 from nine states.[6] Changing population dynamics in the years since that analysis, and an increase in availability of more geographically diverse data, necessitate an updated analysis of more recent years. Other recent analyses either only analyzed overweight and obesity prevalence among women of reproductive age,[5] or among a specific subset of low-income pregnant women.[7] Trend assessments using PRAMS and PNSS data[6,7,13] provide evidence that is contrary to Flegal's results from analyses of women of reproductive age.[5] This discrepancy illustrates the need for additional analysis to conclusively identify the current trend in prevalence of obesity and overweight specifically among the general pregnant population in the US.

Given the known negative health outcomes associated with prepregnancy obesity, both short- and long-term for mother and child, understanding the scope of the problem and its current trajectory is absolutely critical to developing effective interventions and policies to help women enter pregnancy at a healthy weight.

Table 2.1. Summary of the evidence of association between prepregnancy overweight and obesity and maternal and offspring health outcomes.

Health Outcome	Author, year	Study Description, Data Source, Study Period	Sample Size	Measure of Effect	Effect Size		
					Overweight	Obese	Severely Obese
GDM	Chu SY et al., 2007[1]	Meta-analysis, 1980-2006	20 studies	OR	2.14 (1.82-2.53)	3.56 (3.05-4.21)	8.56 (5.07-16.04)
	Torloni MR et al., 2009[2]	Meta-analysis, 1977-2007	70 studies	pooled OR	1.97 (1.77-2.19)	3.01 (2.34-3.87)	5.55 (4.27-7.21)
Preeclampsia	O'Brien TE et al., 2003	Systematic review, 1980-2002	13 studies (n=1,390,226)	AOR	2.1-5.2 (overweight vs. non-overweight)		
Cesarean delivery	Poobalan AS et al., 2009	Meta-analysis, 1996-2007	11 studies (n=209,193)	pooled OR	1.53 (1.48-1.58)	2.26 (2.04-2.51)	3.38 (2.49-4.57)
	Chu SY et al., 2007[3]	Meta-analysis, 1980-2005	33 studies	OR	1.46 (1.34-1.60)	2.05 (1.86-2.27)	2.89 (2.28-3.79)
Breastfeeding duration	Oddy WH et al., 2006	Western Australian Pregnancy Cohort, (prospective, facility-based), 1989-1991 (with 3-year follow-up)	n=1,803	AOR	<2 mos:1.52 (1.11-2.09)	<2 mos: 2.08 (1.39-3.12)	N/A
					<4 mos: 1.62 (1.20-2.18)	<4 mos: 1.98 (1.32-2.95)	
					<6 mos: 1.53 (1.13-2.07)	<6 mos: 1.54 (1.02-2.32)	
				Cox proportional hazard ratio	Overweight/obese combined: 1.18 (1.05-1.34)		
	Li R et al., 2003	Retrospective cohort (PNSS, PedNSS), 1996-1998	n=13,234	Beta coefficient	-0.05 (NS)	-1.73 wks (p<0.01)	N/A
Miscarriage	Boots C et al., 2011	Systematic review (only naturally-occurring pregnancies), 1948-2011	6 studies (n=24,738)	pooled OR	1.11 (1.00-1.24)	1.31 (1.18-1.46)	N/A
	Metwally M et al., 2008	Meta-analysis, 1964-2006	16 studies (n=16,696)	pooled OR (BMI≥25 vs. normal)	Overall: 1.67 (1.25-2.25)		
			9 studies (n=8,403)		IVF-ICSI: NS		
			2 studies (n=2,864)		Oocyte donation: 1.52 (1.10-2.09)		
			3 studies (n=497)		Ovulation induction: 5.11 (1.76-14.83)		
	Lashen H et al., 2004	Nested case-control (Solihull Maternity Unit clinical records, UK), 1985-1999	obese cases: 1,644 normal controls: 3,288	OR	Early miscarriage: 1.2 (1.01-1.46)		
					Recurrent early miscarriage: 3.51 (1.03-12.01)		

Health Outcome	Author, year	Study Description, Data Source, Study Period	Sample Size	Measure of Effect	Effect Size		
					Overweight	Obese	Severely Obese
Stillbirth	Chu SY et al., 2007[4]	Meta-analysis, 1980-2005	9 studies	OR	1.47 (1.08-1.94)	2.07 (1.59-2.74)	N/A
	Flenady V et al., 2011	Meta-analysis, 1998-2009	96 studies	AOR	1.2 (1.09-1.38)	1.6 (1.35-1.95)	N/A
				PAF	7.7%-17.6%		N/A
Fetal macrosomia	Cedergren MI et al., 2004	Prospective cohort (Swedish Medical Birth Registry), 1992-2001	n=972,806	AOR	2.15 (2.08-2.23)	3.03 (2.85-3.21)	3.82 (3.50-4.16)
	Weiss JL et al., 2004	Prospective multicenter cohort (First and Second Trimester Evaluation of Risk (FASTER) trial), years not reported	n=16,102	AOR	N/A	BW>4000g: 1.7 (1.4-2.0)	BW>4000g: 1.9 (1.5-2.3)
						BW>4500g: 2.0 (1.4-3.0)	BW>4500g: 2.4 (1.5-3.8)
	Baeten JM et al., 2001	Cohort study (WA state birth certificates), 1992-1996	n=96,801	AOR	1.5 (1.4-1.6)	2.1 (1.9-2.3)	N/A
Preterm birth	McDonald SD et al., 2010	Meta-analysis, 1976-2006	84 studies (n=1,095,834)	pooled RR - overall	1.03 (0.98-1.07)	1.10 (0.99-1.07)	1.22 (0.86-1.72)
				pooled RR - induced	1.15 (1.04-1.27)	1.56 (1.42-1.71)	1.71 (1.50-1.94)
	Torloni MR et al., 2009[5]	Meta-analysis, 1968-2008	39 studies (n=1,788,633)	pooled AOR - overall	N/A	Class I: 1.08 (0.95-1.23)	Class II: 1.33 (1.12-1.57) Class III: 1.83 (1.62-2.07)
				pooled AOR - spontaneous	N/A	Class I: 0.83 (0.75-0.92)	Class II: 1.04 (0.77-1.41) Class III: unavailable
Neural tube defects	Rasmussen SA et al., 2008	Meta-analysis, 1980-2007	12 studies	OR	1.22 (0.99-1.49)	1.70 (1.34-2.15)	3.11 (1.75-5.46)
	Stothard KJ et al., 2009	Meta-analysis, 1966-2008	18 studies (9 studies of NTDs)	pooled OR	1.20 (1.04-1.38)	1.87 (1.62-2.15)	N/A
Congenital heart defects	Stothard KJ et al., 2009	Meta-analysis, 1966-2008	18 studies (7 studies of CHDs)	pooled OR	1.17 (1.03-1.34)	1.30 (1.12-1.51)	N/A
	Gilboa SM et al., 2010	Case-control study (NBDPS), 1997-2004	cases=6,440; controls=5,673	AOR	1.16 (1.05-1.29)	1.15 (1.00-1.32)	1.31 (1.11-1.56)
Offspring high BMI	Whitaker RC et al.,	Retrospective cohort (Ohio	n=8,494	AOR	2 yrs: 1.42 (1.13-1.79)	2 yrs: 2.28 (1.84-2.83)	2 yrs: 3.05 (2.22-4.18)

Health Outcome	Author, year	Study Description, Data Source, Study Period	Sample Size	Measure of Effect	Effect Size		
					Overweight	Obese	Severely Obese
	2004	WIC recipients), children born 1992-1996			3 yrs: 1.69 (1.35-2.10)	3 yrs: 3.06 (2.49-3.76)	3 yrs: 3.82 (2.80-5.19)
					4 yrs: 1.75 (1.40-2.18)	4 yrs: 3.07 (2.48-3.79)	4 yrs: 4.31 (3.17-5.87)
	Koupil I et al., 2008	Uppsala Birth Cohort offspring (Sweden), men born 1982-1985 who underwent conscript exam at age 18 (this is a subset of overall study sample)	n=,657	AOR	1.23 (1.16-1.30) (odds of overweight or obesity)		
	Gale CR et al., 2007	Prospective cohort (Southampton, UK), births in 1991-1992 (followed up at 9 years)	n=216	Beta coefficient	Boys: 0.26 ($p<0.05$) Girls: 0.42 ($p<0.001$)		

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Chapter 3: Manuscript

Author Contributions

Ms. Fisher had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. She took the lead role in all aspects of this study, including writing and submitting a proposal to procure PRAMS data, cleaning and recoding data, conducting all descriptive and statistical analyses, developing tables and figures, and writing the manuscript in its entirety. Specifically, the authors contributed to the study as follows:

Study concept and design: Fisher, Kim, Sharma

Analysis and interpretation of data: Fisher, Kim, Sharma, Rochat

Drafting of the manuscript, tables, and figures: Fisher

Critical revision of the manuscript for important intellectual content: Fisher, Kim, Sharma, Rochat

Statistical analysis: Fisher, Morrow

Title: Prepregnancy obesity trends in 20 states: Pregnancy Risk Assessment Monitoring System (PRAMS), 2003-2009

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Abstract:

Context Prepregnancy obesity is a well-documented risk factor for a broad range of obstetric complications. Prepregnancy obesity prevalence increased in the US during 1993-2003. Prepregnancy obesity trends have not been assessed since 2003.

Objective To estimate the trend in prepregnancy obesity prevalence among women who delivered live births in the US, by state, age, and race-ethnicity, during 2003-2009.

Design, Setting, and Participants Cross-sectional analyses of the population-based Pregnancy Risk Assessment Monitoring System (PRAMS) during 2003, 2006, and 2009. Response rate thresholds were 70% in 2003 and 2006, and 65% in 2009. The trend analysis included 90,774 records from 20 states with data for all three study years. Prepregnancy obesity was defined as body mass index (BMI) ≥30 kg/m^2, calculated using self-reported height and weight from PRAMS questionnaires.

Main Outcome Measure Trend in prepregnancy obesity prevalence.

Results Prepregnancy obesity prevalence increased by an average of +0.5 percentage points per year, from 17.6% in 2003 to 20.7% in 2009 (p<0.001). Obesity increased among women ages 20-24 (p<0.001), 30-34 (p=0.001), and ≥35 years (p=0.003), and among non-Hispanic white (p<0.001), non-Hispanic black (p=0.02), Hispanic (p=0.01), and other women (p=0.03). Overall, the mean rate of increase slowed from +0.6 percentage points per year during 2003-2006 to +0.4 percentage points per year during 2006-2009. Among non-Hispanic black women, however, the mean rate of increase doubled from +0.4 percentage points per year during 2003-2006 to +0.8 percentage points per year during 2006-2009. In 2009, prepregnancy obesity prevalence was highest among women ≥35 years (24.0%) and non-Hispanic black women (29.2%) and lowest among women <20 years (11.4%) and Asian/Pacific Islanders (7.2%).

Conclusions Prepregnancy obesity prevalence continues to increase, and varies by race-ethnicity and maternal age. These findings highlight the need to address obesity as a key component of preconception care, particularly among high-risk groups.

Introduction

Prepregnancy obesity (body mass index [BMI] ≥30 kg/m^2)[1] is a well-documented risk factor for obstetric complications, including gestational diabetes mellitus, hypertensive disorders, cesarean delivery, miscarriage, stillbirth, fetal macrosomia, preterm birth, and select birth defects.[2-10] These complications also increase treatment costs for prenatal, delivery, and postpartum care of obese women.[11-13]

Despite the association between prepregnancy obesity and poor maternal and child health outcomes, and evidence of high rates of obesity among women of reproductive age,[14] data on obesity trends among women who become pregnant in the United States are limited. Recent evidence on obesity among women of reproductive age (20-39 years) suggests that prevalence has plateaued, but we do not know whether this is true for pregnant women.[15] Two studies of pregnant women show an increasing trend in obesity[16,17]; however, one only examined nine states from 1993-2003,[16] while the other was restricted to a specialized population of low-income women enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) from 1999-2008.[17] In this study we estimate recent trends in prepregnancy obesity prevalence among women who delivered live births in 20 states during 2003-2009.

Methods

Study Population

We analyzed data from the Pregnancy Risk Assessment Monitoring System (PRAMS), an ongoing state-based population-based surveillance system that collects information on maternal behaviors before, during, and after pregnancy ending in live birth. Using birth certificates, PRAMS samples live births delivered by state residents within the previous two to four months, with a maximum allowable recall period of nine months postpartum. Self-administered questionnaires are mailed to respondents' homes, with telephone follow-up for non-responders. Each questionnaire is linked to the respondent's child's birth certificate. Data are weighted to adjust for survey design, non-coverage, and non-response. More detail on PRAMS methodology is available on the PRAMS website (http://www.cdc.gov/prams/methodology).

We used 2003, 2006, and 2009 data from states that met the PRAMS response rate threshold of at least 70% response in 2003 or 2006, or at least 65% response in 2009. Thirty-six states and New York City met these criteria in at least one of the three study years and 20 states met these criteria in all three study years. We excluded records (6.0%; n=7,323) missing BMI or with biologically implausible height (<48 or >78 inches), weight (<75 or >500 pounds), or BMI (<12.55 or >77.79 kg/m^2 based on the data's upper and lower 0.01 percentile).[18-20] After exclusions, a total of 114,899 records remained; among the 20 consistently-reporting states, 90,744 records were available for trend analysis, representing more than 3.2 million births, or 26% of all births in the US during the study years.[18-20]

For women ≥20 years, we calculated BMI as *(weight in kilograms)/(height in meters)*^{2}, based on self-reported height and weight from PRAMS questionnaires. We categorized adult women as underweight (BMI<18.5 kg/m^2), normal-weight (BMI 18.5-24.9 kg/m^2), overweight (BMI 25-29.9 kg/m^2), and obese (BMI ≥30 kg/m^2). For sub-analyses, we further categorized obesity into class I (BMI 30-34.9 kg/m^2), class II (BMI 35-39.9 kg/m^2), and class III (BMI ≥40 kg/m^2).[1]

For adolescent women <20 years, we used the 2000 CDC Growth Charts to calculate BMI-for-age percentile scores.[21] We estimated maternal birth date using PRAMS data for maternal birth year and setting maternal birth date to July 1. We estimated maternal age (in months) at delivery using infant birth month and year from the birth certificate and setting infant birth day to 15. The estimated maternal age has a maximum error of 6.5 months, which has a negligible effect on the BMI-for-age calculation. We categorized adolescent women as underweight (<5th BMI-for-age percentile), normal-weight (5th-84.9th BMI-for-age percentile), overweight (85th-94.9th BMI-for-age percentile), and obese (≥95th BMI-for-age percentile).[22] For sub-analyses, we classified adolescent women in the 95th-96.9th BMI-for-age percentile as moderately obese, and women in the ≥97th BMI-for-age percentile as severely obese.[23]

We categorized maternal race-ethnicity, as reported on the birth certificate, as: non-Hispanic white, non-Hispanic black, Hispanic, American Indian/Alaskan Native, Asian/Pacific Islander, and other. We grouped Chinese, Japanese, Filipino, Hawaiian, and “Other Asian” into the Asian/Pacific Islander category; “other” includes those who reported “mixed race” or any race-ethnicity other than those described above. On the 2003 birth certificate, respondents may select Hispanic ethnicity and a separate race category (e.g. black, white). We categorized anyone who reported Hispanic ethnicity as Hispanic, regardless of any secondary race classification.

We used Medicaid and WIC enrollment as dichotomous proxy indicators of socioeconomic status. We recorded women as enrolled in Medicaid if they reported using Medicaid before pregnancy, for prenatal care, or for delivery care. We defined WIC enrollment as having received WIC assistance during pregnancy. We categorized women as having smoked before pregnancy if they reported on the PRAMS questionnaire that they smoked >0 cigarettes per day in the three months before pregnancy.

Statistical Analysis

We calculated the prevalence and standard error of each BMI category for each state contributing to each study year. To account for changing demographics over time, we restricted trend analyses to the 20 states with PRAMS data for all three study years: 2003, 2006, and 2009. Previous studies indicate that prepregnancy obesity prevalence is associated with maternal age and race-ethnicity, and that the distribution of these demographics of pregnant women in the U.S is changing.[16,17,24] We directly standardized the overall prevalence of each BMI category for each study year and the overall obesity trend to the 2003 age and race-ethnicity distribution among the 20 consistently-reporting states. We report crude and standardized overall prevalence and trend estimates. To estimate the trajectory of the trends over time, we calculated the mean annual percentage point change in obesity prevalence by comparing 2003 to 2006, 2006 to 2009, and 2003 to 2009. We used a Cochrane-Mantel-Haenszel chi-square test for trend to determine the significance of the trend in obesity prevalence over the study period. For all analyses, we considered a p-value <0.05 as statistically significant.

We also calculated the prevalence of each prepregnancy obesity class by state, stratified by adults and adolescents. We calculated the state-specific trend for each obesity class, as well as the crude and standardized trends among the 20 consistently-reporting states. Finally, we estimated the 2009 prevalence of each BMI group, overall and by maternal age and race-ethnicity, using data from all states (n=29) with 2009 data.

Data were weighted to account for survey design, non-response, and non-coverage. We used SAS-callable SUDAAN 10.0.1 for all statistical analyses.

Results

Across all three time points, survey participants were predominantly non-Hispanic white, married, had some post-high school education, were not enrolled in WIC or Medicaid, and were non-smokers before pregnancy (Table 1). The exact distribution of these demographic characteristics changed over time, however. Compared to 2003, in 2009 fewer women were non-Hispanic white, and more were educated post-high school, unmarried, enrolled in WIC and Medicaid, and reported smoking prior to pregnancy.

Overall, the prevalence of prepregnancy obesity increased between 2003 and 2009 ($p<0.001$), from 17.6% in 2003 to 20.7% in 2009 (Table 2). The rate of increase slowed over time, from a mean of +0.6 percentage points per year in 2003-2006 to +0.4 percentage points per year in 2006-2009. The prevalence of prepregnancy overweight also increased over the study period, from 22.9% to 24.3% ($p=0.04$), while the proportion of women entering pregnancy at a normal weight decreased from 54.6% to 51.4% ($p<0.001$). When standardized by maternal age and race-ethnicity, the estimates remained similar.

Obesity increased among women ages 20-24, 30-34, and ≥35 years ($p<0.001$, $p=0.001$, $p=0.003$, respectively), but not among other age groups (Table 2). Obesity also increased among women categorized as non-Hispanic white, non-Hispanic black, Hispanic, and other ($p<0.001$, $p=0.02$, $p=0.01$, $p=0.03$, respectively). The rate of increase in prepregnancy obesity prevalence decreased in 2006-2009 compared to 2003-2006 among all age and racial-ethnic groups except women categorized as non-Hispanic black or other. Among non-Hispanic black women the mean rate of increase in prepregnancy obesity doubled from a rate of +0.4 percentage points per year in 2003-2006 to +0.8 percentage points per year in 2006-2009.

Obesity prevalence increased during 2003-2009 in eight states: Arkansas, Maryland, Michigan, Mississippi, Nebraska, New Jersey, Oklahoma, and Washington (Table 2). The average annual rate of increase in prepregnancy obesity prevalence in these states ranged from +0.6 percentage points per year in Michigan to +1.2 percentage points per year in Oklahoma. Arkansas was the only state with a significant trend where prepregnancy obesity increased at a faster rate in the second half of the study period than in the first half (+0.5 points/year in 2003-2006, +1.1 points/year in 2006-2009).

Prevalence estimates from states with data available for any of the three study years suggest that the proportion of states with prepregnancy obesity prevalence ≥20% increased over the time period (Figure 1). In 2003, 26% (7/27) of states had prepregnancy obesity prevalence ≥20%; in 2009, 66% (19/29) of states had prepregnancy obesity prevalence ≥20%.

Among adults, the prevalence of all three obesity classes increased over time (Table 3). Class I obesity prevalence increased from 10.7% to 11.9% ($p=0.004$), class II obesity prevalence increased from 4.7% to 5.7% ($p=0.001$), and class III obesity prevalence increased from 3.1% to 4.0% ($p=0.001$). Among adolescent women (Table 4), severe obesity increased, from 3.9% to 6.1% ($p=0.03$); the prevalence of moderate obesity did not change. Direct standardization did not meaningfully affect the prevalence or trend estimates for either adult or adolescent obesity sub-classes.

Finally, among all states that contributed data in 2009 (n=29), the prevalence (SE) of prepregnancy underweight, normal-weight, overweight, and obesity were: 3.9% (0.2), 50.2% (0.5), 24.5% (0.4), and 21.4% (0.4), respectively (data not shown). When stratified by race-ethnicity, non-Hispanic black women and American Indian/Alaskan Native women had the highest prepregnancy obesity prevalence (29.2% [1.0] and 28.9% [2.7], respectively). Asian/Pacific Islander women had the lowest prepregnancy obesity prevalence (7.2%, [0.8]). Non-Hispanic white and Hispanic women had a prevalence of 20.0% (0.4) and 23.2% (1.3), respectively. Women ≥35 years had the highest prepregnancy obesity prevalence (24.0% [1.1]); women <20 years had the lowest (11.4% [1.0]).

Comment

These PRAMS data indicate the proportion of women in the US who are obese upon entering pregnancy continues to increase. Results of direct standardization by maternal age and race-ethnicity indicate that this trend was not affected by changing demographics. Overall, the rate of increase appears to be slowing; however this rate varies by state, maternal age, and race-ethnicity. In 2009, more than one in five pregnant women were obese across almost every age and racial-ethnic group.

This study provides the only evidence of current prepregnancy obesity prevalence and trends among the general population in the US Our findings are consistent with earlier studies that found increasing trends in prepregnancy obesity, while expanding the population to which these results can be generalized. An earlier analysis used PRAMS 1993-2003 to analyze prepregnancy obesity trends, but was limited to nine states and only differentiated race-ethnicity as white, black, and other.[16] A more recent study of prepregnancy obesity trends in the US was limited to adult women enrolled in WIC during 1999-2008.[17] To our knowledge, ours is the first study to assess trends by obesity severity among adolescent pregnant women. Due to expanded geographic coverage (20 states), differentiation between six race-ethnicity categories, and broader criteria to include women regardless of socioeconomic status, our study provides the most representative data on prepregnancy obesity in the US.

Our study confirms previous findings that prepregnancy obesity varies among states.[24] We hypothesize that this may be due, in part, to varying racial-ethnic and maternal age distributions.[20] Prepregnancy obesity has been shown to be associated with maternal race-ethnicity and age,[16] and our data suggest that states with large or growing populations of older and/or non-Hispanic black or Hispanic women may exhibit greater prevalence and trends of prepregnancy obesity than other states. The relationship between maternal age and obesity is biologically plausible, particularly due to the association between parity and prepregnancy obesity.[16] Additional research is needed to identify the specific drivers of racial-ethnic differences in obesity. Socioeconomic status may be an underlying factor, as a determinant of access to healthy food and physical activity resources.[25]

Our obesity trend among pregnant women differs from recent data on obesity among women of reproductive age. NHANES data do not indicate an increase in obesity among women ages 20-39 during 1999-2008.[15] These differences indicate that pregnant women and women of reproductive age are two distinct populations that should be analyzed separately when examining obesity. The latter includes women regardless of pregnancy status, with a large proportion (18%) who will never give birth.[26] There are also methodological differences between NHANES and PRAMS; with a smaller sample size (n=877), the NHANES study has less power to detect changes in prevalence.

Evidence of the continued increase in prepregnancy obesity is particularly concerning given the known dose-response relationship of increased risk of obstetric complications with increasing prepregnancy BMI.[27] Our data show that the prevalence of severe obesity is increasing among pregnant women, suggesting a growing burden of complications on mothers, their offspring, and the health system. Costs for prenatal care may be as much as five times higher for obese than normal-weight women, with additional delivery and postpartum costs associated with longer hospital stays, more procedures to address complications, and increased infections requiring treatment.[11-13] Additionally, prepregnancy obesity has been linked to later overweight and obesity among offspring, thus perpetuating an obesity cycle.[28] According to our findings, in 2009 46% of US women entered pregnancy at above normal weight, making high prepregnancy BMI an extremely common risk factor for adverse obstetric outcomes.

Given the health implications and the scope of prepregnancy obesity, obesity should be addressed as a key component of preconception care among sexually active women. With approximately 49% of pregnancies in the US unintended, many women do not have the opportunity to lose weight in preparation for a planned pregnancy.[29] Our evidence indicates that prepregnancy obesity is high across almost all subgroups; but it is highest and increasing faster among non-Hispanic black women than other race-ethnicities and is very high among American Indian/Alaskan Native women. Previous research shows that obesity is also highest among least-educated and low-income women.[30] Emphasis should be placed on ensuring access to weight management counseling and treatment as a standard component of routine preconception care, particularly among high-risk groups. Both the US Centers for Disease Control and Prevention and the American College of Obstetricians and Gynecologists recommend preconception care, including screening for risk factors such as obesity.[31,32] Counseling on nutrition and exercise, as well as appropriate contraceptive use, are critical in ensuring a healthy weight is achieved prior to pregnancy. However, lack of providers offering this kind of preconception care, lack of public awareness to seek preconception care services, and lack of insurance coverage represent significant barriers to access.[32,33] The trend indicated in our study provides evidence that current efforts to provide these services are insufficient, with negative health effects reflected among pregnant women at the population level.

Our analysis is limited to those states that contributed data for the three study years, and may not be representative of the entire United States. However, with population-based data from 20 states, our study is considerably more representative than the previous nine-state analysis.[16]

Without any other nationally representative data on prepregnancy obesity, our study is among the most rigorous current estimates of the overall prepregnancy obesity prevalence and trends in the US. We chose to limit our trend analysis to three time points in order to maximize the number of states included and thus better approximate national representation. Our sub-analysis of the 18 states for which data was available for all years between 2003 and 2009 validated the obesity trend that we found using three years, indicating an overall increase from 16.5% in 2003 to 19.9% in 2009 ($p<0.001$) (See Appendix).

Additionally, the respondents included in this study may differ from those that were excluded or failed to respond to PRAMS. PRAMS systematically excludes women who had abortions, stillbirths, or fetal deaths, and state residents who gave birth in a different state; stillbirth and fetal death are both associated with prepregnancy obesity.[6,34] For this analysis, records excluded due to missing data were disproportionately young, Hispanic, had ≥2 previous live births, had completed <12 years of education, were unmarried, non-smokers, and enrolled in WIC and Medicaid ($p<0.001$). PRAMS non-respondents are also likely to be non-white, unmarried, or less educated.[30] Current evidence suggests that obesity is more prevalent among non-Hispanic black and other minority women, women with less education, and women enrolled in WIC.[16,35] Based on the characteristics of women excluded from this analysis, we infer that missing data results in a slight underestimate of prepregnancy obesity.

Finally, BMI data from PRAMS is based on maternal self-report, which may be biased. A large systematic review found that women tend to underestimate self-reported weight compared to clinical measurement, leading to an underestimate of their BMI.[36] The 2001-2006 NHANES confirmed that women ages 16-79 significantly underreport their weight by an average of three pounds.[37] A study of pregnant women, however, found that self-reporting bias was minimal and only significant for underweight women (who overreported weight by 2.4 pounds).[38] Thus, misclassification due to reporting bias may result in a slightly conservative estimate of obesity prevalence.

In conclusion, our results indicate that prepregnancy obesity prevalence is high and continues to increase in the US, with potential for substantial public and clinical health implications. The US Department of Health and Human Services has identified increasing the proportion of women who enter pregnancy at a healthy weight as a public health priority in its Healthy People 2020 initiative[39]; yet our data indicate that this trend is moving in the opposite direction. This study provides additional evidence that we may not meet the Healthy People 2020 target of 53% of women entering pregnancy at a healthy weight. Regular surveillance is needed to better understand the health needs of this population and inform targeted, effective interventions to reduce obesity among pregnant women.

Author Contributions

Ms. Fisher had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Fisher, Kim, Sharma

Analysis and interpretation of data: Fisher, Kim, Sharma, Rochat

Drafting of the manuscript: Fisher

Critical revision of the manuscript for important intellectual content: Fisher, Kim, Sharma, Rochat

Statistical analysis: Fisher, Morrow

Conflict of Interest Disclosures

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Disclaimer

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Tables and Figures

Table 3.1. Maternal characteristics, among states with data for all three years (20 states), 2003, 2006, 2009. Values are weighted percent (standard error).

Characteristic	2003	2006	2009	p-value
Maternal Age (yrs)				<0.001
<20	9.2 (0.3)	9.1 (0.3)	9.0 (0.3)	
20-24	25.5 (0.4)	23.7 (0.4)	22.8 (0.4)	
25-29	27.3 (0.4)	28.9 (0.4)	30.1 (0.4)	
30-34	24.7 (0.4)	23.9 (0.4)	24.4 (0.4)	
≥35	13.4 (0.3)	14.4 (0.3)	13.8 (0.3)	
Maternal Race-Ethnicity				<0.001
Non-Hispanic White	69.1 (0.3)	66.9 (0.4)	64.9 (0.4)	
Non-Hispanic Black	13.1 (0.3)	13.1 (0.3)	13.6 (0.2)	
Hispanic	11.3 (0.3)	12.6 (0.3)	13.1 (0.3)	
American Indian/Alaskan Native	1.2 (0.1)	1.3 (0.1)	1.3 (0.1)	
Asian/Pacific Islander	4.9 (0.1)	5.1 (0.2)	5.0 (0.1)	
Other	0.4 (0.1)	1.1 (0.1)	2.1 (0.1)	
Parity				0.16
0	41.2 (0.5)	40.8 (0.5)	40.7 (0.5)	
1	32.1 (0.4)	31.9 (0.4)	33.2 (0.4)	
≥2	26.7 (0.4)	27.2 (0.4)	26.1 (0.4)	
Maternal Education (yrs)				<0.001
<12	15.6 (0.4)	15.2 (0.3)	14.3 (0.3)	
12	31.9 (0.4)	29.1 (0.4)	26.7 (0.42)	
≥13	52.5 (0.5)	55.8 (0.4)	59.0 (0.5)	
Married	67.2 (0.4)	65.8 (0.4)	62.5 (0.4)	<0.001
WIC enrolled	39.0 (0.4)	40.3 (0.4)	44.5 (0.5)	<0.001
Medicaid enrolled	40.1 (0.4)	43.0 (0.4)	46.8 (0.5)	<0.001
Smoking before pregnancy	24.5 (0.4)	24.5 (0.4)	26.9 (0.4)	<0.001

Table 3.2. Prevalence of pre-pregnancy BMI categories by state, maternal age group, and maternal race-ethnicity, 2003, 2006, 2009. Values are weighted percent (standard error).

	Underweight			Normal- Weight			Overweight		
	2003	**2006**	**2009**	**2003**	**2006**	**2009**	**2003**	**2006**	**2009**
Overall[a]	4.9 (0.2)	4.3 (0.2)	3.7 (0.2)	54.6 (0.5)	52.4 (0.5)	51.4 (0.5)	22.9 (0.4)	23.9 (0.4)	24.3 (0.4)
Overall[b]	4.9 (0.2)	4.4 (0.2)	3.7 (0.2)	54.5 (0.5)	52.4 (0.5)	51.5 (0.5)	23.0 (0.4)	23.8 (0.4)	24.3 (0.4)
State									
AL	4.8 (0.7)	-	-	52.1 (1.7)	-	-	22.0 (1.4)	-	-
AK	3.4 (0.6)	3.3 (0.6)	1.7 (0.5)	50.4 (1.5)	50.8 (1.7)	49.1 (1.8)	27.2 (1.3)	26.1 (1.5)	27.7 (1.6)
AR	5.1 (0.7)	5.1 (0.7)	5.1 (0.9)	50.6 (1.6)	48.0 (1.5)	46.3 (2.0)	23.5 (1.4)	24.7 (1.3)	23.1 (1.7)
CO	4.6 (0.6)	4.8 (0.7)	4.4 (0.6)	61.4 (1.4)	55.6 (1.7)	59.2 (1.6)	22.5 (1.2)	21.0 (1.3)	22.6 (1.4)
DE	-	-	4.2 (0.6)	-	-	48.9 (1.6)	-	-	23.5 (1.4)
FL	5.2 (0.8)	-	-	54.2 (1.7)	-	-	21.8 (1.4)	-	-
GA	-	3.5 (0.6)	4.2 (1.1)	-	50.5 (1.6)	44.5 (2.6)	-	24.7 (1.4)	31.1 (2.4)
HI	6.1 (0.7)	5.2 (0.5)	3.9 (0.6)	57.0 (1.4)	59.0 (1.2)	57.1 (1.6)	21.7 (1.1)	21.8 (1.1)	21.9 (1.4)
IL	4.2 (0.6)	4.0 (0.5)	3.7 (0.5)	53.8 (1.4)	52.9 (1.4)	50.0 (1.4)	24.4 (1.2)	23.8 (1.2)	26.1 (1.3)
LA	6.7 (0.7)	-	-	55.8 (1.4)	-	-	20.4 (1.2)	-	-
ME	4.1 (0.7)	4.3 (0.7)	3.2 (0.6)	55.1 (1.7)	51.9 (1.7)	50.6 (1.8)	21.0 (1.4)	22.5 (1.4)	24.7 (1.6)
MD	4.1 (0.8)	3.8 (0.8)	3.0 (0.7)	53.4 (2.0)	51.9 (1.9)	53.3 (2.0)	25.8 (1.7)	24.2 (1.7)	21.9 (1.6)
MA	-	-	2.8 (0.6)	-	-	57.3 (1.8)	-	-	21.4 (1.5)
MI	5.8 (0.7)	4.7 (0.7)	3.0 (0.5)	49.9 (1.5)	48.7 (1.8)	51.4 (1.5)	25.8 (1.3)	24.6 (1.5)	23.9 (1.3)
MN	3.5 (0.6)	4.0 (0.5)	2.3 (0.4)	58.9 (1.5)	52.3 (1.3)	53.2 (1.5)	20.6 (1.3)	26.3 (1.2)	26.7 (1.3)
MS	5.3 (0.8)	4.4 (0.8)	5.2 (0.8)	48.9 (1.7)	47.4 (2.1)	45.1 (1.7)	24.0 (1.5)	22.1 (1.7)	22.0 (1.4)
MO	-	-	4.7 (0.8)	-	-	48.6 (1.7)	-	-	23.9 (1.4)
NE	2.9 (0.4)	4.4 (0.7)	3.4 (0.5)	57.9 (1.4)	52.8 (1.6)	51.5 (1.5)	23.3 (1.2)	23.6 (1.3)	24.1 (1.2)
NJ	5.2 (0.6)	4.9 (0.5)	4.2 (0.6)	60.6 (1.2)	57.7 (1.3)	54.6 (1.5)	21.2 (1.0)	21.7 (1.1)	23.2 (1.3)
NM	4.0 (0.6)	-	-	55.3 (1.5)	-	-	21.3 (1.2)	-	-
NY	4.2 (0.8)	2.7 (0.9)	-	57.9 (1.8)	55.8 (2.7)	-	20.0 (1.5)	22.7 (2.3)	-
NYC	-	5.8 (0.8)	-	-	58.8 (1.7)	-	-	21.2 (1.4)	-
NC	3.8 (0.6)	-	-	51.1 (1.7)	-	-	23.8 (1.5)	-	-
OH	6.1 (0.9)	4.2 (0.7)	4.1 (0.8)	50.2 (1.8)	49.8 (1.7)	47.1 (1.8)	20.1 (1.4)	25.7 (1.5)	25.3 (1.6)
OK	6.0 (0.9)	4.4 (0.8)	4.1 (0.8)	52.6 (1.9)	48.3 (1.9)	49.3 (1.9)	24.6 (1.6)	24.6 (1.7)	22.9 (1.6)
OR	3.8 (0.8)	3.5 (0.7)	2.9 (0.6)	56.7 (2.1)	51.8 (1.9)	52.9 (1.9)	21.5 (1.7)	22.1 (1.6)	24.3 (1.6)
PA	-	-	4.3 (0.7)	-	-	51.6 (1.8)	-	-	22.0 (1.5)

RI	4.3 (0.6)	3.4 (0.6)	4.2 (0.7)	56.7 (1.6)	54.0 (1.7)	50.7 (1.7)	22.2 (1.3)	24.3 (1.4)	26.7 (1.5)
SC	6.0 (1.0)	3.7 (1.1)	-	49.5 (2.2)	54.3 (3.0)	-	22.6 (1.8)	19.5 (2.3)	-
TN	-	-	4.7 (1.1)	-	-	50.3 (2.5)	-	-	23.2 (2.1)
TX	-	-	3.9 (0.6)	-	-	47.1 (1.6)	-	-	24.6 (1.4)
UT	5.2 (0.7)	5.0 (0.6)	4.9 (0.6)	60.2 (1.6)	58.8 (1.3)	55.9 (1.4)	20.5 (1.3)	22.5 (1.2)	22.9 (1.2)
VT	3.5 (0.5)	3.1 (0.5)	3.0 (0.5)	55.9 (1.4)	53.8 (1.5)	54.0 (1.6)	22.0 (1.2)	23.7 (1.3)	23.3 (1.3)
WA	4.8 (0.8)	3.8 (0.7)	2.6 (0.6)	55.9 (1.9)	52.9 (1.8)	51.0 (1.8)	23.2 (1.6)	24.7 (1.5)	26.1 (1.6)
WV	7.4 (0.9)	6.7 (0.8)	5.6 (0.7)	51.3 (1.8)	45.8 (1.8)	45.9 (1.6)	19.9 (1.4)	23.5 (1.5)	23.2 (1.3)
WI	-	-	4.3 (0.8)	-	-	51.4 (1.9)	-	-	24.6 (1.7)
WY	-	-	4.9 (0.9)	-	-	53.3 (2.0)	-	-	21.2 (1.6)
Maternal Age (yrs)[a]									
<20	5.0 (0.7)	4.2 (0.6)	3.7 (0.6)	69.8 (1.5)	67.4 (1.5)	69.2 (1.5)	16.5 (1.2)	17.8 (1.3)	16.5 (1.2)
20-24	6.9 (0.5)	6.3 (0.5)	5.3 (0.4)	53.5 (0.9)	49.7 (1.0)	48.5 (1.0)	21.9 (0.7)	23.8 (0.8)	24.4 (0.9)
25-29	5.0 (0.4)	4.1 (0.3)	3.7 (0.3)	50.7 (0.9)	50.3 (0.8)	48.6 (0.8)	24.0 (0.8)	25.0 (0.7)	25.8 (0.7)
30-34	3.7 (0.4)	3.6 (0.3)	3.1 (0.3)	54.8 (0.9)	53.2 (0.9)	51.9 (0.9)	23.9 (0.8)	23.8 (0.8)	24.1 (0.8)
≥35	3.3 (0.4)	2.9 (0.4)	2.0 (0.3)	53.6 (1.2)	50.1 (1.1)	49.6 (1.2)	25.0 (1.0)	25.7 (1.0)	26.2 (1.1)
Maternal Race-Ethnicity[a]									
Non-Hispanic White	5.0 (0.3)	4.3 (0.2)	3.6 (0.2)	56.8 (0.6)	54.0 (0.6)	53.4 (0.6)	21.8 (0.5)	23.0 (0.5)	23.5 (0.5)
Non-Hispanic Black	3.2 (0.4)	4.0 (0.5)	3.5 (0.4)	43.2 (1.2)	40.5 (1.2)	40.6 (1.1)	27.1 (1.1)	27.9 (1.1)	25.9 (1.0)
Hispanic	4.1 (0.5)	4.0 (0.5)	2.6 (0.4)	50.9 (1.3)	50.5 (1.2)	48.3 (1.2)	27.4 (1.2)	26.0 (1.1)	28.0 (1.1)
American Indian/ Alaskan Native	3.1 (0.9)	2.6 (1.0)	5.3 (1.7)	46.9 (2.6)	43.4 (3.0)	42.4 (2.8)	27.3 (2.3)	26.4 (2.6)	26.2 (2.4)
Asian/Pacific Islander	10.4 (1.0)	8.1 (0.9)	6.9 (0.8)	64.5 (1.5)	65.7 (1.5)	62.9 (1.6)	16.4 (1.2)	18.1 (1.3)	21.8 (1.4)
Other	12.4 (5.5)	3.6 (1.3)	4.0 (1.2)	43.6 (6.6)	62.4 (4.2)	54.0 (3.2)	27.6 (5.9)	26.6 (4.0)	20.6 (2.4)

[a]Includes only states with data for all 3 years (20 states)
[b]Includes only states with data for all 3 years (20 states), standardized by age and race-ethnicity

Table 3.2 (continued). Prevalence of pre-pregnancy BMI categories by state, maternal age group, and maternal race-ethnicity, 2003, 2006, 2009. Values are weighted percent (standard error).

	Obese			Mean Annual Percentage Point Change in Obesity			P-trend (Obesity)
	2003	2006	2009	2003-2006	2006-2009	2003-2009	
Overall[a]	17.6 (0.4)	19.5 (0.4)	20.7 (0.4)	0.6	0.4	0.5	<0.001
Overall[b]	17.6 (0.4)	19.5 (0.4)	20.5 (0.4)	0.6	0.4	0.4	<0.001
State							
AL	21.1 (1.4)	-	-	-	-	-	-
AK	19.0 (1.2)	19.9 (1.3)	21.4 (1.5)	0.3	0.5	0.4	0.18
AR	20.8 (1.3)	22.3 (1.3)	25.5 (1.8)	0.5	1.1	0.8	0.03
CO	11.5 (0.9)	18.6 (1.4)	13.8 (1.1)	2.4	-1.6	0.4	0.11
DE	-	-	23.5 (1.4)	-	-	-	-
FL	18.8 (1.3)	-	-	-	-	-	-
GA	-	21.3 (1.3)	20.2 (2.0)	-	-0.4	-	-
HI	15.3 (1.0)	14.1 (0.9)	17.1 (1.3)	-0.4	1.0	0.3	0.25
IL	17.6 (1.1)	19.3 (1.1)	20.2 (1.1)	0.5	0.3	0.4	0.11
LA	17.1 (1.1)	-	-	-	-	-	-
ME	19.8 (1.4)	21.3 (1.4)	21.5 (1.5)	0.5	0.1	0.3	0.40
MD	16.4 (1.5)	20.1 (1.6)	21.9 (1.6)	1.2	0.2	0.9	0.02
MA	-	-	18.4 (1.5)	-	-	-	-
MI	18.5 (1.2)	22.1 (1.5)	21.8 (1.2)	1.2	-0.1	0.6	0.04
MN	17.0 (1.2)	17.4 (1.0)	17.9 (1.2)	0.1	0.2	0.2	0.57
MS	21.8 (1.4)	26.2 (1.8)	27.7 (1.5)	1.5	0.5	1.0	0.004
MO	-	-	22.8 (1.4)	-	-	-	-
NE	15.9 (1.0)	19.2 (1.3)	21.0 (1.2)	1.1	0.6	0.9	0.001
NJ	13.0 (0.9)	15.8 (0.9)	18.0 (1.1)	0.9	0.8	0.8	<0.001
NM	19.4 (1.2)	-	-	-	-	-	-
NY	17.9 (1.4)	18.9 (2.1)	-	0.3	-	-	-
NYC	-	14.2 (1.2)	-	-	-	-	-
NC	21.3 (1.4)	-	-	-	-	-	-
OH	23.6 (1.5)	20.3 (1.4)	23.5 (1.6)	-1.1	1.1	0.0	0.94
OK	16.8 (1.4)	22.7 (1.6)	23.7 (1.6)	2.0	0.3	1.2	0.001
OR	18.0 (1.6)	22.6 (1.6)	19.9 (1.6)	1.5	-0.9	0.3	0.42

PA	-	-	22.0 (1.5)	-	-	-	-
RI	16.8 (1.2)	18.2 (1.3)	18.4 (1.3)	0.5	0.1	0.3	0.35
SC	22.0 (1.8)	22.6 (2.5)	-	0.2	-	-	-
TN	-	-	21.8 (2.0)	-	-	-	-
TX	-	-	24.3 (1.4)	-	-	-	-
UT	14.2 (1.1)	13.7 (0.9)	16.2 (1.1)	-0.2	0.8	0.3	0.18
VT	18.7 (1.1)	19.5 (1.2)	19.7 (1.3)	0.3	0.1	0.2	0.57
WA	16.1 (1.4)	18.6 (1.4)	20.3 (1.5)	0.8	0.6	0.7	0.04
WV	21.3 (1.5)	24.05 (1.5)	25.2 (1.4)	0.9	0.4	0.7	0.05
WI	-	-	19.7 (1.5)	-	-	-	-
WY	-	-	20.5 (1.6)	-	-	-	-
Maternal Age (yrs)[a]							
<20	8.7 (0.9)	10.6 (1.0)	10.6 (1.0)	0.6	0.0	0.3	0.16
20-24	17.8 (0.7)	20.2 (0.8)	21.8 (0.8)	0.8	0.5	0.7	<0.001
25-29	20.3 (0.7)	20.7 (0.7)	21.9 (0.7)	0.1	0.4	0.3	0.11
30-34	17.6 (0.7)	19.4 (0.7)	21.0 (0.8)	0.6	0.5	0.6	0.001
≥35	18.1 (0.9)	21.3 (1.0)	22.2 (1.0)	1.1	0.3	0.7	0.003
Maternal Race-Ethnicity[a]							
Non-Hispanic White	16.5 (0.4)	18.8 (0.5)	19.5 (0.5)	0.8	0.2	0.5	<0.001
Non-Hispanic Black	26.4 (1.1)	27.7 (1.1)	30.0 (1.0)	0.4	0.8	0.6	0.02
Hispanic	17.6 (1.0)	19.5 (1.0)	21.2 (1.0)	0.7	0.5	0.6	0.01
American Indian/ Alaskan Native	22.7 (2.0)	27.6 (2.5)	26.2 (2.4)	1.6	-0.5	0.6	0.27
Asian/Pacific Islander	8.7 (0.9)	8.0 (0.7)	8.4 (0.8)	-0.2	0.1	0.0	0.84
Other	16.4 (5.0)	7.4 (1.7)	21.3 (3.0)	-3.0	4.7	0.8	0.03

[a]Includes only states with data for all 3 years (20 states)
[b]Includes only states with data for all 3 years (20 states), standardized by age and race-ethnicity

Figure 3.1. Prepregnancy obesity prevalence, by state, 2003, 2006, 2009**.**

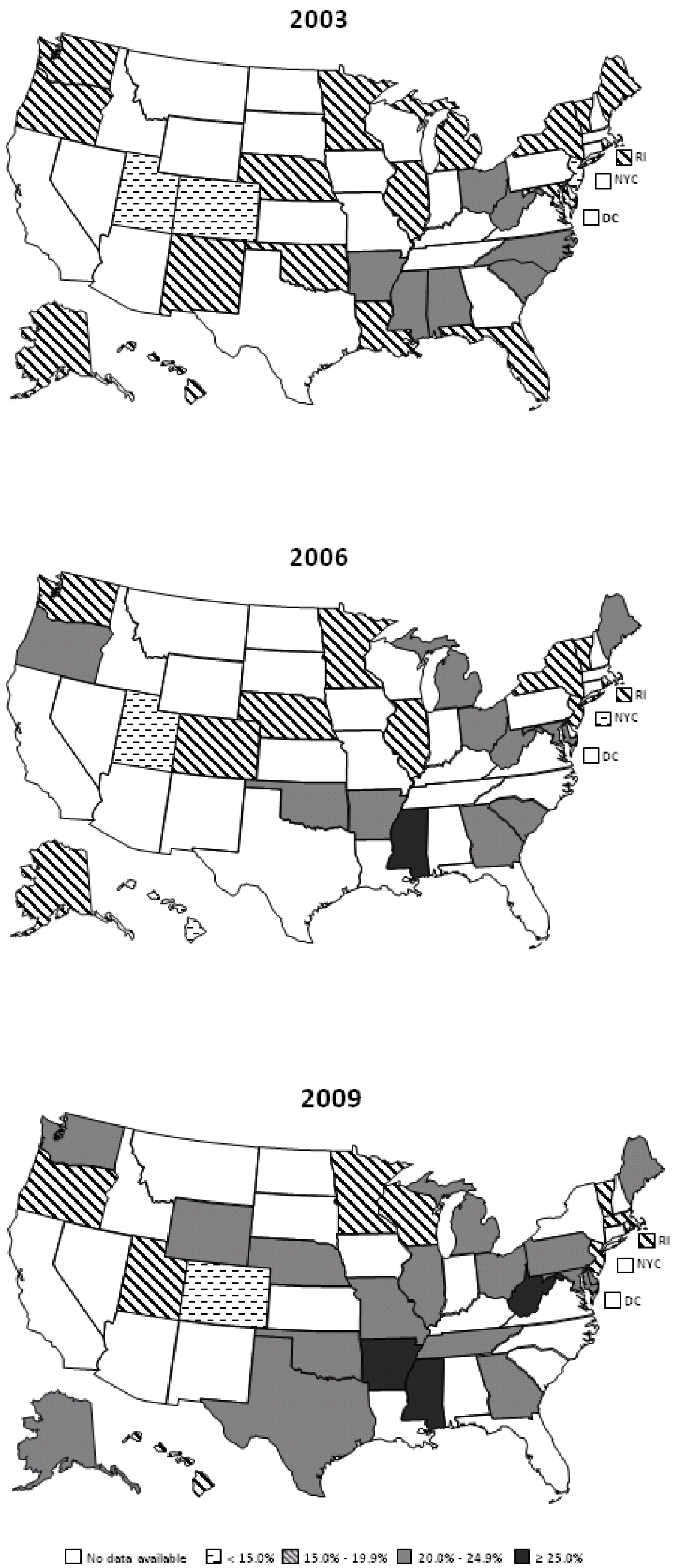

Table 3.3. Prepregnancy obesity prevalence among women ≥20 years by obesity severity and state, 2003, 2006, 2009. Values are weighted percent (standard error).												
	Obese Class I				**Obese Class II**				**Obese Class III**			
	2003	**2006**	**2009**	**p-trend**	**2003**	**2006**	**2009**	**p-trend**	**2003**	**2006**	**2009**	**p-trend**
Overall[a]	10.7 (0.3)	11.8 (0.3)	11.9 (0.3)	0.004	4.7 (0.2)	5.2 (0.2)	5.7 (0.2)	0.001	3.1 (0.2)	3.4 (0.2)	4.0 (0.2)	<0.001
Overall[b]	9.7 (0.3)	10.7 (0.3)	10.7 (0.3)	0.009	4.3 (0.2)	4.7 (0.2)	5.2 (0.2)	0.001	2.8 (0.2)	3.1 (0.2)	3.6 (0.2)	<0.001
State												
AL	13.0 (1.2)	-	-	-	6.8 (0.9)	-	-	-	3.2 (0.6)	-	-	-
AK	10.8 (1.0)	11.6 (1.1)	12.4 (1.2)	0.29	5.6 (0.7)	5.9 (0.8)	6.6 (0.9)	0.37	3.8 (0.6)	3.7 (0.7)	3.8 (0.7)	1.00
AR	12.4 (1.2)	11.8 (1.1)	15.4 (1.6)	0.11	6.0 (0.8)	6.8 (0.8)	8.5 (1.2)	0.10	4.6 (0.7)	5.3 (0.7)	4.1 (0.8)	0.59
CO	7.3 (0.8)	11.0 (1.1)	7.7 (0.9)	0.72	2.9 (0.5)	4.4 (0.8)	4.2 (0.6)	0.09	2.0 (0.4)	3.8 (0.8)	2.7 (0.6)	0.33
DE	-	-	12.4 (1.1)	-	-	-	6.3 (0.8)	-	-	-	5.8 (0.8)	-
FL	14.0 (1.3)	-	-	-	3.6 (0.6)	-	-	-	2.4 (0.5)	-	-	-
GA	-	11.1 (1.1)	10.6 (1.6)	-	-	7.2 (0.9)	7.2 (1.5)	-	-	4.5 (0.7)	3.1 (0.9)	-
HI	9.8 (0.8)	9.8 (0.8)	11.7 (1.1)	0.18	3.9 (0.6)	3.8 (0.5)	4.2 (0.7)	0.71	2.2 (0.4)	1.8 (0.4)	2.2 (0.5)	0.97
IL	10.9 (1.0)	12.7 (1.0)	12.6 (1.0)	0.23	4.5 (0.6)	4.6 (0.6)	5.2 (0.7)	0.43	3.3 (0.6)	2.7 (0.5)	3.6 (0.6)	0.80
LA	9.5 (0.9)	-	-	-	6.0 (0.7)	-	-	-	3.9 (0.6)	-	-	-
ME	10.6 (1.1)	12.8 (1.2)	11.8 (1.2)	0.48	6.1 (0.8)	6.0 (0.8)	4.9 (0.8)	0.32	3.4 (0.6)	3.2 (0.6)	5.8 (0.9)	0.03
MD	8.3 (1.1)	11.3 (1.3)	13.1 (1.4)	0.007	5.3 (0.9)	6.9 (1.1)	5.3 (0.9)	0.99	4.3 (0.9)	2.6 (0.6)	4.0 (0.8)	0.78
MA	-	-	9.7 (1.1)	-	-	-	6.8 (1.0)	-	-	-	1.7 (0.5)	-
MI	11.2 (1.0)	12.3 (1.2)	12.2 (1.0)	0.44	4.7 (0.7)	6.1 (0.8)	6.1 (0.7)	0.15	3.3 (0.6)	4.5 (0.8)	5.1 (0.7)	0.05
MN	10.4 (1.0)	10.7 (0.8)	11.9 (1.0)	0.28	4.4 (0.7)	5.2 (0.6)	4.0 (0.6)	0.67	3.0 (0.5)	2.3 (0.4)	2.6 (0.5)	0.58
MS	13.1 (1.2)	12.7 (1.5)	16.7 (1.4)	0.05	6.9 (0.9)	8.9 (1.3)	7.4 (1.0)	0.69	3.4 (0.6)	7.2 (1.1)	7.0 (0.9)	0.002
MO	-	-	12.6 (1.2)	-	-	-	6.3 (0.9)	-	-	-	5.4 (0.8)	-
NE	10.2 (0.9)	12.8 (1.1)	12.6 (1.0)	0.08	4.7 (0.6)	5.1 (0.8)	5.6 (0.7)	0.31	1.9 (0.4)	2.6 (0.5)	3.6 (0.6)	0.01
NJ	8.6 (0.7)	9.8 (0.8)	11.5 (1.0)	0.02	3.0 (0.5)	4.6 (0.6)	3.6 (0.6)	0.38	1.8 (0.3)	2.0 (0.4)	3.0 (0.5)	0.06
NM	14.6 (1.2)	-	-	-	4.7 (0.7)	-	-	-	2.5 (0.5)	-	-	-
NY	12.9 (1.3)	13.0 (1.9)	-	-	3.5 (0.7)	3.4 (1.0)	-	-	2.3 (0.6)	3.2 (1.0)	-	-

NYC	-	9.2 (1.0)	-	-	-	3.2 (0.6)	-	-	-	2.0 (0.5)	-	-
NC	12.2 (1.2)	-	-	-	5.3 (0.8)	-	-	-	5.2 (0.8)	-	-	-
OH	13.9 (1.3)	12.6 (1.2)	11.3 (1.2)	0.13	6.5 (0.9)	5.1 (0.8)	8.0 (1.1)	0.30	4.6 (0.8)	3.9 (0.7)	5.5 (0.9)	0.49
OK	11.6 (1.3)	12.8 (1.3)	14.2 (1.4)	0.17	4.4 (0.8)	6.1 (0.9)	6.5 (1.0)	0.11	2.8 (0.6)	5.3 (0.9)	4.5 (0.8)	0.11
OR	11.1 (1.3)	12.4 (1.3)	11.6 (1.3)	0.76	5.0 (1.0)	6.7 (1.0)	4.8 (0.8)	0.83	2.4 (0.7)	4.4 (0.9)	4.1 (0.8)	0.10
PA	-	-	13.3 (1.3)	-	-	-	6.4 (0.9)	-	-	-	3.8 (0.7)	-
RI	10.6 (1.0)	11.2 (1.1)	11.7 (1.1)	0.47	4.3 (0.7)	5.2 (0.8)	3.7 (0.7)	0.57	2.5 (0.5)	3.0 (0.6)	3.5 (0.7)	0.24
SC	11.5 (1.5)	14.3 (2.3)	-	-	7.4 (1.2)	5.3 (1.4)	-	-	4.3 (0.9)	4.1 (1.2)	-	-
TN	-	-	10.4 (1.6)	-	-	-	7.4 (1.4)	-	-	-	5.5 (1.2)	-
TX	-	-	15.2 (1.3)	-	-	-	7.0 (0.9)	-	-	-	4.0 (0.7)	-
UT	10.3 (1.0)	9.5 (0.8)	9.0 (0.9)	0.34	2.9 (0.6)	2.8 (0.4)	5.3 (0.7)	0.006	1.7 (0.4)	2.0 (0.4)	2.4 (0.5)	0.31
VT	12.1 (1.0)	13.1 (1.1)	10.1 (1.0)	0.16	4.2 (0.6)	4.0 (0.6)	6.1 (0.8)	0.06	3.1 (0.5)	3.1 (0.6)	4.0 (0.7)	0.30
WA	9.1 (1.1)	12.1 (1.2)	10.8 (1.1)	0.29	4.9 (0.9)	3.9 (0.8)	6.4 (1.0)	0.21	2.3 (0.5)	3.2 (0.7)	3.5 (0.7)	0.18
WV	12.9 (1.4)	14.0 (1.4)	14.4 (1.2)	0.41	6.1 (0.9)	6.4 (1.0)	7.0 (0.9)	0.50	4.4 (0.8)	5.8 (0.9)	6.9 (0.9)	0.03
WI	-	-	11.4 (1.3)	-	-	-	5.0 (0.9)	-	-	-	4.3 (0.8)	-
WY	-	-	13.4 (1.4)	-	-	-	5.1 (1.1)	-	-	-	3.7 (0.7)	-

[a]Includes only states with data for all 3 years (20 states)

[b]Includes only states with data for all 3 years (20 states), standardized by age and race-ethnicity

Table 3.4. Prepregnancy obesity prevalence among women <20 years by obesity severity and by state, 2003, 2006, 2009. Values are weighted percent (standard error).

	Moderate Obesity				Severe Obesity			
	2003	**2006**	**2009**	**p-trend**	**2003**	**2006**	**2009**	**p-trend**
Overall[a]	4.8 (0.8)	5.3 (0.8)	4.6 (0.6)	0.79	3.9 (0.6)	5.3 (0.7)	6.1 (0.8)	0.03
Overall[b]	4.9 (0.7)	5.4 (0.8)	4.6 (0.7)	0.81	3.9 (0.6)	5.2 (0.7)	6.3 (0.8)	0.02
State								
AL	2.3 (1.1)	-	-	-	8.1 (2.4)	-	-	-
AK	5.6 (2.3)	1.1 (0.6)	4.3 (2.6)	0.76	2.6 (0.8)	5.2 (2.2)	5.5 (2.5)	0.31
AR	1.8 (0.9)	4.9 (1.8)	1.8 (1.0)	0.95	6.2 (2.0)	7.4 (2.1)	7.5 (3.1)	0.72
CO	3.0 (1.9)	5.7 (3.2)	1.7 (0.7)	0.53	1.3 (0.9)	5.9 (2.8)	3.2 (1.4)	0.28
DE	-	-	4.4 (2.3)	-	-	-	9.7 (3.3)	-
FL	3.6 (1.5)	-	-	-	5.2 (1.7)	-	-	-
GA	-	7.2 (2.8)	8.1 (3.8)	-	-	3.8 (1.6)	8.5 (3.8)	-
HI	4.4 (1.7)	0 (0)	3.8 (1.9)	0.89	4.1 (1.8)	0 (0)	4.4 (2.4)	0.86
IL	5.0 (2.0)	3.9 (1.8)	4.7 (2.0)	0.92	3.0 (1.7)	8.5 (2.7)	5.6 (2.1)	0.33
LA	2.3 (1.1)	-	-	-	2.2 (1.2)	-	-	-
ME	6.2 (3.3)	6.7 (4.4)	6.0 (3.3)	0.96	9.7 (4.0)	4.9 (2.9)	2.8 (2.1)	0.13
MD	2.9 (1.8)	9.0 (3.9)	7.5 (4.9)	0.29	2.8 (2.2)	4.8 (3.2)	7.5 (4.9)	0.36
MA	-	-	6.5 (4.3)	-	-	-	16.5 (6.8)	-
MI	5.9 (2.6)	6.8 (2.5)	6.5 (2.5)	0.87	5.1 (2.1)	7.0 (3.0)	1.7 (0.7)	0.11
MN	0.7 (0.4)	3.8 (2.1)	2.2 (1.2)	0.15	1.7 (0.7)	1.1 (1.1)	1.4 (0.8)	0.73
MS	7.0 (2.2)	5.8 (2.5)	4.4 (1.8)	0.36	6.7 (2.3)	5.2 (2.5)	4.6 (1.7)	0.45
MO	-	-	6.2 (2.9)	-	-	-	2.9 (1.2)	-
NE	1.9 (0.7)	1.2 (0.7)	4.0 (1.9)	0.31	5.0 (2.3)	2.4 (1.1)	5.3 (2.4)	0.98
NJ	5.2 (2.4)	2.0 (1.3)	8.5 (3.9)	0.50	1.6 (1.1)	4.7 (2.5)	8.7 (3.8)	0.07
NM	1.4 (0.7)	-	-	-	4.2 (1.4)	-	-	-
NY	2.8 (2.8)	0.5 (0.5)	-	-	5.6 (3.8)	10.4 (7.0)	-	-
NYC	-	4.2 (2.6)	-	-	-	7.0 (3.7)	-	-
NC	3.5 (2.1)	-	-	-	6.2 (2.7)	-	-	-
OH	8.3 (3.5)	6.7 (2.8)	2.1 (1.0)	0.11	2.8 (2.1)	2.9 (0.9)	9.4 (3.8)	0.13
OK	2.1 (1.3)	8.2 (3.6)	2.5 (1.6)	0.87	2.7 (1.5)	3.9 (2.2)	11.6 (3.6)	0.03
OR	8.1 (4.4)	3.2 (1.0)	7.0 (4.0)	0.85	5.1 (2.6)	9.2 (4.0)	4.7 (3.0)	0.93
PA	-	-	4.5 (2.7)	-	-	-	1.9 (1.9)	-
RI	3.0 (1.7)	2.0 (1.6)	5.9 (2.9)	0.39	6.4 (2.6)	3.7 (2.2)	7.4 (3.1)	0.81
SC	6.3 (3.0)	2.3 (2.3)	-	-	7.2 (3.4)	13.2 (5.8)	-	-
TN	-	-	7.0 (3.2)	-	-	-	6.2 (3.3)	-
TX	-	-	6.5 (2.4)	-	-	-	5.1 (1.8)	-
UT	3.0 (2.7)	2.4 (1.0)	5.5 (2.6)	0.49	0.1 (0.1)	2.4 (1.4)	4.5 (1.9)	0.03
VT	3.4 (2.6)	5.6 (2.8)	2.5 (2.3)	0.73	1.0 (0.4)	5.6 (2.8)	10.9 (4.4)	0.04
WA	3.8 (1.9)	6.4 (3.2)	8.0 (3.7)	0.34	10.0 (4.4)	6.1 (3.1)	7.2 (3.3)	0.63
WV	3.1 (0.7)	4.3 (0.8)	3.0 (1.3)	0.89	3.7 (0.8)	5.1 (0.9)	6.5 (2.0)	0.20
WI	-	-	4.4 (2.8)	-	-	-	5.1 (3.0)	-

WY	-	-	5.2 (2.6)	-	-	-	1.8 (1.1)	-
[a]Includes only states with data for all 3 years (20 states)								
[b]Includes only states with data for all 3 years (20 states), standardized by age and race-ethnicity								

Chapter 4: Conclusion and Recommendations

Effective policies and interventions must target the underlying risk factors associated with prepregnancy obesity. The available data indicate that low-income women, non-Hispanic Black and Hispanic women, older women, and parous women are at increased risk of prepregnancy obesity. Factors driving this trend are likely diverse, including access to health care, healthy food, and physical activity resources; language barriers impeding comprehension of health promotion messages; and biological changes affecting metabolism as women age and/or bear children. Many women may face several of these obstacles at once, further reducing self-efficacy in instituting long-term behavior change. Any approach to addressing prepregnancy obesity must be comprehensive, with a dual focus on both individual and social determinants of health.

Public Health Implications

The high prevalence of prepregnancy overweight and obesity in the US makes it a major public health concern. According to our study, in 2009 almost half of pregnant women (46%) were at increased risk of obstetric complications due to overweight or obesity—this translates to more than 900,000 women and their infants. These risks, and their associated costs, have both short- and long-term effects on women and their offspring. Obese women are more likely than normal-weight women to experience prenatal and delivery complications, as well as suffer from long-term chronic disease such as type 2 diabetes. The offspring of women who are obese during pregnancy are also more likely to experience obesity and chronic disease later in life, thus continuing a vicious cycle. This increased risk of chronic disease has unmistakable consequences in reduced workforce productivity and overall quality of life for Americans.

Additionally, all of these health concerns place a substantial financial burden on the health care system, due to the costs associated with obstetric complications, more invasive delivery procedures, longer hospital stays, and long-term health conditions on the part of both mother and child. Given that prepregnancy obesity is more common among women enrolled in federal assistance programs such as Medicaid, these excess costs are often borne by US taxpayers, in addition to individual patients and insurers. Although an exact cost estimate is elusive, due to the challenge of predicting long-term intergenerational effects of prepregnancy obesity, it will undoubtedly continue to grow if the proportion of women who are overweight and obese entering pregnancy also continues to grow.

Policy Implications

New evidence of the high and increasing prevalence of prepregnancy obesity presents justification for refocusing existing US policies aimed at maternal and child health. Despite recognition in the Healthy People 2020 goals and in recommendations put forth by both the Centers for Disease Control and Prevention (CDC) and the American College of Obestetricans and Gynecologists, current policy efforts to address prepregnancy obesity are clearly insufficient. In the face of increasing prepregnancy obesity, there is a need to enhance current policies promoting preconception care that includes weight management, as well as obesity prevention and reduction efforts among the general population as a whole.

At the clinical level, preconception care is key to addressing obesity prior to pregnancy. However, most current insurance plans and Medicaid do not cover separate preconception care visits in addition to standard primary or prenatal care.[85] And without explicit coverage of preconception care services as a component of routine primary or gynecological care, it is difficult for providers to allocate time accordingly because financial incentives from insurance companies are not aligned with the provision of preventive care services.[86] Many components of what might be included in preconception care (e.g. prescription drugs, diagnostic screening, preventive and rehabilitative services) are only considered optional services under Medicaid, so access to these services varies considerably by state. Furthermore, Medicaid is currently targeted towards women who are already pregnant or who have children, so most low-income nulliparous women do not qualify for coverage prior to conception.[85] Uninsured women have the lowest utilization of preconception care services, presumably due to cost.[87] Many of these women are, however, eligible for expanded Medicaid coverage specifically for family planning services; but these family planning waivers do not currently include coverage for preventive services, such as preconception care.[88]

Preconception care, however, is only one piece of the puzzle. Even among women who do have access to health care services, they may not be receptive to counseling on prepregnancy obesity. Qualitative research reveals that many women are skeptical of the obstetric risks associated with obesity, and perceive doctors' attempts to discuss weight loss with hostility.[89] These perceptions may vary by race-ethnicity—one study found that overweight and obese black and Hispanic participants were less likely than white participants to believe that their BMI was damaging their health, regardless of receipt of provider advice on the subject.[90] Furthermore, the argument for preconception care may not be the most effective message for obese women during routine Ob/Gyn visits, when they are often deliberately seeking contraceptive services in order to avoid becoming pregnant.[65] Doctors themselves admit pessimism in regards to their efficacy in addressing obesity—a study of obstetrician/gynecologists found that, although most of the providers surveyed reported offering counseling on weight management and physical activity to their patients, the majority (69%) did not believe that they can actually help patients lose weight.[82]

Provider pessimism may be due, in part, to recognition of the importance of lifestyle factors that lead to obesity and are difficult to change—sedentary behavior, unhealthy eating, busy schedules, among others. Many of these habits are instilled from an early age, and continue causing obesity in adolescence and adulthood. A number of federal and state programs aim to address these lifestyle factors, including the recent *Let's Move!* initiative, which aims to reduce childhood obesity—and subsequently adult obesity—by promoting physical activity and healthy eating among children and their families.[91] This highly-publicized program is based on a set of recommendations put forth by the White House Task Force on Childhood Obesity.[92] *Let's Move!* acknowledges the role of parents in promoting healthy lifestyles among their children, but stops short of messaging that promotes the potential health benefits to parents. Nor does the program place any emphasis on specific subgroups of children, such as adolescent girls.

The CDC's Nutrition, Physical Activity and Obesity Program is state-based and broad in scope; however the only component focused specifically on women of reproductive age is limited to breastfeeding promotion activities.[93] Another CDC effort, *LEAN Works!* is part of a national effort to address obesity due to increasingly sedentary work habits among adults, without differentiating by gender. Recommendations include improving access to healthy food options (e.g. in workplace cafeterias and/or vending machines), or to physical activity resources, such as building an on-site gym or facilitating fitness competitions among employees.[94] However, these recommendations are based on research that focused primarily on "white-collar" work environments, with limited data on differential effects based on race-ethnicity or gender.[95]

Nevertheless, the specific lifestyle barriers to maintaining a healthy weight that women at the highest risk of prepregnancy obesity face deserve attention. Women are more likely than men to be employed part-time,[96] which may limit opportunities to participate in workplace-based obesity reduction interventions that are designed around a more traditional work schedule. Additionally, workplace-based programs that require taking time out of the day may be less feasible for hourly workers, who may lose compensation for less time worked.

The built environment also plays an important role as a determinant of obesity, including among women who become pregnant. Neighborhood resources for physical activity, perceived safety, and proximity to healthy food options all may affect one's ability to maintain a healthy weight, regardless of one's access to formal preconception care. We know that women who are obese upon entering pregnancy are more likely to be low-income; residence in a low-socioeconomic status (SES) neighborhood has been shown to be associated with increased BMI over time.[97] Among women, specifically, low-income women or those living in low-SES neighborhoods differentially benefit from the availability of physical activity resources than higher-income women.[98] Some evidence also suggests that neighborhood disadvantage explains some of the racial-ethnic disparities in obesity among young women (ages 17-21), as non-Hispanic black and Hispanic women are more likely to live in low-SES neighborhoods than non-Hispanic white women.[77]

Access to healthy food is an additional concern for women living in low-SES neighborhoods. Fewer grocery stores are located within low-SES communities, where residents may be less likely to have adequate transportation for traveling longer distances for food. Instead, low-income residents more often resort to items that can be purchased in local convenience stores or at fast food retailers, which may be cheaper and/or more convenient, but also tend to be less nutritious.[99] WIC is an important federal resource for improving access to better nutrition among low-income women, through provision of supplemental food packages that meet federal nutrition requirements. However, WIC eligibility requires that one is already pregnant, breastfeeding, or lactating, after which only children up to 5 years are eligible.[100]

Recommendations

Surveillance

The first step in addressing prepregnancy obesity is increasing public understanding of the current prevalence and trends. This requires data to inform stakeholders at all levels, starting with national policymakers. To do this, increased surveillance of the health status of pregnant women is imperative. The present study challenges the assumption that data on women of reproductive age can be applied to pregnant women. The health of pregnant women is important not only for the women themselves, but for the health of the next generation. With better surveillance data on pregnant women, specifically, evidence-based health promotion policies and programs can be designed that are more likely to be relevant and effective. One existing data source is birth certificates. The 2003 US birth certificate already collects maternal height and prepregnancy weight data, but these data are not publicly available beyond the state level. Making these data available for national analyses will greatly improve researchers' ability to assess national prepregnancy obesity prevalence and trends. Data that can be extrapolated to local level conditions are also necessary; state and district health departments are often responsible for implementing public health programs. Information on prepregnancy obesity at the sub-state level will help ensure that those efforts are evidence-based and appropriate.

Preconception Care as a Component of Primary Care

Given the frequency of unintended pregnancy in the US, preconception care cannot be restricted to only women who are planning to become pregnant. Instead, we need to broaden the traditional concept of preconception care to include appropriate screening and counseling on relevant risk factors, such as obesity, among all sexually active women, as a component of routine primary and/or gynecologic care. The Patient Protection and Affordable Care Act (ACA), signed into law in 2010, is a step in this direction with its strong focus on mandated preventive care coverage. This will include coverage of services such as healthy diet counseling, obesity screening, and behavioral interventions for obese adults.[101] ACA will also remove categorical eligibility criteria under Medicaid, substantially improving poor women's access to obesity screening and clinical preventive services before they become pregnant. Under new income-based eligibility criteria, an estimated more than 8 million previously uninsured women will qualify for Medicaid.[102]

Insurance coverage does not, however, guarantee that women will actually receive quality preconception care, or that it will translate into behavior change. Many US women see a gynecologist/obstetrician for routine care; however, specialists, such as obstetrician/gynecologists, tend to be less likely to accept Medicaid patients because of low reimbursement rates relative to private insurance,[85] presenting another obstacle to care for poor women. Although ACA promises to raise Medicaid reimbursement rates temporarily, concern remains over the workforce capacity to meet increased demand with expanded Medicaid coverage.[103] As a long-term approach, states should be incentivized to increase obstetrician/gynecologist participation in Medicaid. Additionally, the content of preconception care is critical; obesity screening and counseling are one aspect, but just as important is the promotion of effective, long-term reversible contraceptive methods in order to avoid unintended pregnancy, at least until a healthy weight has been achieved.

Inclusion of women as priority group in existing policies/interventions

The national *Let's Move!* initiative focuses on reducing childhood obesity, but it can be argued that childhood obesity may actually start much earlier, in the fetal environment. Thus, it is important to not only focus on children, but also their mothers, who may still become pregnant again. The *Let's Move!* program currently advocates for family physical activities and healthy meals, but without mentioning the important health benefits that these lifestyle changes can have on parents as well as children.[104] New messages encouraging parents to become healthier, for the sake of both current and future children, may improve family-wide participation. Additionally, a special focus on adolescent girls is needed; given that half of adolescents become sexually active during their teen years, and experience very high rates of unintended pregnancy,[105] this is an important life stage during which to address prepregnancy obesity.

Workplace obesity programs also tend to overlook the needs of part-time or shift-bound workers, many of whom are women at risk of prepregnancy obesity. More research is needed on nutrition and exercise programs in non-white collar work environments, such as service industry, retail, and teaching jobs, as well as those programs' effect on women's BMI, specifically. CDC recommendations should also be expanded to include ways in which part-time or hourly workers can participate in workday nutrition and exercise programs, without sacrificing pay or free time.

Environmental interventions

In 2009, CDC issued a set of 24 recommendations for community strategies to prevent obesity in the US.[106] Among these were approaches to improve the availability of healthy food and to increase physical activity. Statistical modeling based on consumer behavior has shown that subsidies for fruits and vegetables would increase consumption among low-income Americans.[107] WIC already provides food assistance for pregnant and lactating women; states may consider expanding WIC eligibility criteria for a longer postpartum time period, in order to prevent interconception weight gain and future prepregnancy obesity. CDC also recommends increasing access to supermarkets selling affordable healthy food.[106] Introduction of a supermarket into a low-SES community may provide an array of benefits, including improving neighborhood retail value, boosting local economic activity, and lowering prices for fruits and vegetables.[108] States can encourage supermarkets to invest in underserved areas through tax incentives, zoning regulations, and loan offerings.[106]

Cities and states should also be encouraged to improve sidewalks, neighborhood safety, and access to outdoor recreational facilities. Women's physical activity, more so than men's, is influenced by perceived neighborhood safety, the obvious presence of others being physically active, and availability of physical activity resources.[98,109] Mothers' perception of neighborhood safety is also associated with their daughters' BMI, presumably due to hesitance to allow daughters to play outside in unsafe neighborhoods.[110] Federal policies and grant programs to encourage these kinds of community improvements would motivate states to take action, with long-term benefits for women.

Conclusion

Preventing and combating obesity is a public health issue that lacks a simple solution. Improved preconception care will benefit many women, but unintended pregnancy will remain a challenge. Furthermore, environmental factors outside of health providers' control may limit women's ability to adopt and maintain healthy lifestyles. Medicaid expansions, tax incentives for grocery stores in low-income neighborhoods, and environmental improvement projects address some disparities in access to weight management resources; but they also rely on available government funding and political will.

However, given the large—and increasing—proportion of women in the US who are obese when they become pregnant, and the negative health effects associated with prepregnancy obesity, addressing this issue is a national public health concern. Investments in researching and implementing more effective approaches to addressing prepregnancy obesity now will reduce obstetric complications, reduce chronic disease among women and their offspring, and interrupt the obesity cycle in the US, yielding reduced health care costs, increased economic productivity, and a healthier population in generations to come.

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Appendix: Interpretation of sub-analysis of all years, 2003-2009

Following the same methodology described in Chapter 3, we conducted a sub-analysis of the 18 states that consistently contributed PRAMS data for all years during 2003-2009. Demographic characteristics were similar between the two samples (Appendix Table 1), as were the overall trend estimates (Appendix Table 2) As noted earlier, the overall trend estimate based on seven time points indicated an overall increase in prepregnancy obesity from 16.5% in 2003 to 19.9% in 2009 ($p<0.0001$) (Appendix Table 2).

Analysis of additional time points altered the trend estimates for some individual states. Five states demonstrated significantly increasing prepregnancy obesity trends: Colorado, Nebraska, New Jersey, Oklahoma, and West Virginia (Appendix Table 2). Two of these states—Colorado and West Virginia—did not have significant trends based on the analysis of only three time points. Four states that had significant trends based on the three-year analysis—Arkansas, Maryland, Michigan, and Washington—were not significant based on the seven-year analysis. Mississippi was the only state with a significant trend based on the three-year analysis that was excluded from the seven-year analysis, due to missing data in 2005 and 2007.

Generally, those states for which trends that had been significant based on the three-year analysis became insignificant based on the seven-year analysis were ones that appear to have fluctuating prepregnancy obesity prevalence. When all seven points are plotted on a graph, it is clear how prevalence in 2003, 2006, and 2009 appears to be linear, and how data from the intervening years negates those trends (Appendix Figure 1).

Prepregnancy obesity is significantly increasing among women ages 20-24 and ≥35 according to both analyses. The trend among women ages 25-29 became significant when all years were considered; the trend among women ages 30-34 became insignificant. Prepregnancy obesity trends by race-ethnicity were similar in both analyses. In the seven-year analysis, however, there was no significant trend among women categorized as “other.”

When we analyzed obesity according to class, all three adult obesity classes remained significant overall (Appendix Table 3). Compared with the three-year analysis, the increase in class I obesity became more significant ($p<0.001$ vs. $p=0.004$), whereas the increase in class II obesity became less significant ($p=0.04$ vs. $p=0.001$). Among adolescents, severe obesity was no longer significant ($p=0.09$).

The fact that our results from the seven-year analysis differed in some ways from the three-year analysis highlights the limitations of trend analyses based on few time points. Our three-year analysis relied heavily on assumptions of linearity between known time points, which our seven-year analysis indicates were not always valid. Conversely, including fewer states in the analysis compromises our study’s overall geographic representation. It is important to note that, even in the seven-year analyses, no subgroup demonstrated a decreasing trend in prepregnancy obesity. Furthermore, because of the fluctuating prevalence estimates among some states, it is not entirely clear whether there actually is no trend in prepregnancy obesity prevalence, or whether the years with outlying prevalence estimates are simply distracting from an existing trend. As more years of PRAMS data become available, we need to re-analyze these trends with more time points in order to address this question. At this time, however, the present results confirm our previous conclusions that, overall, prepregnancy obesity is high and increasing in the US, and that this trend varies by state, maternal age, and race-ethnicity.

Appendix Table 1. Maternal characteristics among states with data for all time points (18 states), 2003-2009. Values are percent (standard error).

Characteristic	**Overall**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**p-value**
Maternal Age (yrs)									0.0000
<20	8.7 (0.1)	8.7 (0.3)	8.4 (0.3)	8.7 (0.3)	8.6 (0.3)	8.9 (0.3)	9.2 (0.3)	8.6 (0.3)	
20-24	23.1 (0.2)	24.5 (0.4)	23.7 (0.4)	22.9 (0.4)	23.2 (0.4)	22.4 (0.4)	22.6 (0.4)	22.0 (0.4)	
24-29	29.1 (0.2)	27.2 (0.4)	28.6 (0.4)	29.1 (0.4)	29.0 (0.4)	29.6 (0.4)	29.8 (0.4)	30.0 (0.4)	
30-34	24.5 (0.2)	25.4 (0.4)	24.8 (0.4)	24.0 (0.4)	24.4 (0.4)	24.2 (0.4)	23.9 (0.4)	25.0 (0.4)	
≥35	14.7 (0.1)	14.2 (0.3)	14.6 (0.3)	15.3 (0.3)	14.9 (0.3)	14.9 (0.3)	14.5 (0.3)	14.4 (0.3)	
Maternal Race-Ethnicity									0.0000
Non-Hispanic White	66.0 (0.1)	67.8 (0.4)	67.5 (0.4)	67.0 (0.4)	65.7 (0.4)	65.6 (0.4)	64.5 (0.4)	63.7 (0.4)	
Non-Hispanic Black	11.9 (0.1)	11.5 (0.3)	11.8 (0.3)	11.9 (0.3)	11.8 (0.3)	12.2 (0.3)	12.1 (0.3)	11.9 (0.3)	
Hispanic	14.0 (0.1)	13.1 (0.3)	13.2 (0.3)	13.5 (0.3)	14.4 (0.3)	13.8 (0.3)	14.7 (0.3)	15.1 (0.3)	
American Indian/Alaskan Native	1.5 (0.0)	1.4 (0.1)	1.4 (0.1)	1.5 (0.1)	1.5 (0.1)	1.7 (0.1)	1.5 (0.1)	1.5 (0.1)	
Asian/Pacific Islander	5.6 (0.1)	5.6 (0.2)	5.4 (0.1)	5.2 (0.1)	5.6 (0.1)	5.9 (0.2)	5.6 (0.1)	5.7 (0.2)	
Other	1.1 (0.0)	0.5 (0.1)	0.7 (0.1)	1.0 (0.1)	1.1 (0.1)	1.0 (0.1)	1.5 (0.1)	2.1 (0.1)	
Parity									0.0443
0	41.3 (0.2)	41.1 (0.5)	41.2 (0.5)	40.9 (0.5)	40.9 (0.5)	41.5 (0.5)	42.0 (0.5)	41.5 (0.5)	
1	32.5 (0.2)	32.0 (0.4)	32.6 (0.4)	32.4 (0.5)	32.3 (0.4)	32.7 (0.4)	32.4 (0.4)	32.7 (0.4)	
≥2	26.2 (0.2)	26.9 (0.4)	26.2 (0.4)	26.6 (0.4)	26.8 (0.4)	25.7 (0.4)	25.6 (0.4)	25.8 (0.4)	
Maternal Education (yrs)									0.0000
<12	14.8 (0.1)	15.0 (0.3)	14.9 (0.4)	14.2 (0.3)	14.9 (0.3)	16.3 (0.4)	14.2 (0.3)	14.0 (0.3)	
12	28.9 (0.2)	31.4 (0.4)	29.4 (0.4)	29.8 (0.4)	29.0 (0.4)	28.1 (0.4)	28.3 (0.4)	26.6 (0.4)	
≥13	56.3 (0.2)	53.6 (0.5)	55.7 (0.5)	55.8 (0.5)	56.1 (0.5)	55.6 (0.4)	57.5 (0.5)	59.4 (0.5)	
Married	66.5 (0.2)	68.7 (0.4)	68.2 (0.4)	67.3 (0.5)	67.3 (0.4)	65.6 (0.4)	64.5 (0.4)	64.2 (0.4)	0.0000
WIC enrolled	40.2 (0.2)	38.0 (0.5)	39.1 (0.5)	40.6 (0.5)	39.4 (0.4)	39.9 (0.4)	41.4 (0.4)	43.4 (0.5)	0.0000

Medicaid enrolled	42.5 (0.2)	39.1 (0.5)	40.6 (0.5)	43.3 (0.5)	42.2 (0.5)	42.9 (0.4)	43.9 (0.5)	45.5 (0.5)	0.0000
Smoking before pregnancy	23.6 (0.2)	23.3 (0.4)	24.5 (0.4)	23.3 (0.4)	23.5 (0.4)	23.1 (0.4)	22.3 (0.4)	25.5 (0.4)	0.3286

Appendix Table 2. Pre-pregnancy BMI, by State, 2003-2009. Values are percent (standard error).

	Underweight							Normal-Weight						
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Overall – Crude[a]	4.8 (0.2)	4.5 (0.2)	3.9 (0.2)	4.4 (0.2)	3.9 (0.2)	3.6 (0.2)	3.6 (0.2)	55.5 (0.5)	54.5 (0.5)	54.0 (0.5)	52.9 (0.2)	53.6 (0.5)	53.6 (0.5)	52.3 (0.05)
Overall – Standardized[b]	4.7 (0.2)	4.5 (0.2)	3.9 (0.2)	4.4 (0.2)	3.9 (0.2)	3.7 (0.2)	3.5 (0.2)	55.3 (0.5)	54.6 (0.5)	54.2 (0.5)	53.1 (0.5)	53.7 (0.5)	53.6 (0.5)	52.4 (0.5)
State														
AL	4.8 (0.7)	-	-	-	-	-	-	52.1 (1.7)	-	-	-	-	-	-
AK	3.4 (0.6)	3.0 (0.6)	3.1 (0.6)	3.3 (0.6)	2.8 (0.6)	2.7 (0.6)	1.7 (0.5)	50.4 (1.5)	54.4 (1.7)	51.8 (1.7)	50.8 (1.7)	50.4 (1.7)	52.9 (1.8)	49.1 (1.8)
AR	5.1 (0.7)	6.6 (0.8)	5.7 (0.7)	5.1 (0.7)	4.2 (0.6)	4.7 (0.7)	5.1 (0.9)	50.6 (1.6)	47.8 (1.6)	50.6 (1.5)	48.0 (1.5)	48.9 (1.6)	48.0 (1.7)	46.3 (2.0)
CO	4.6 (0.6)	5.3 (0.7)	4.7 (0.7)	4.8 (0.7)	4.3 (0.6)	4.2 (0.7)	4.4 (0.6)	61.4 (1.4)	58.7 (1.7)	59.2 (1.7)	55.6 (1.7)	54.9 (1.6)	27.8 (1.6)	59.2 (1.6)
DE	-	-	-	-	4.8 (0.9)	4.1 (0.6)	4.2 (0.6)	-	-	-	-	48.8 (2.1)	48.3 (1.5)	48.9 (1.6)
FL	5.2 (0.8)	6.2 (0.8)	6.3 (0.8)	-	-	-	-	54.2 (1.7)	55.7 (1.6)	56.4 (1.6)	-	-	-	-
GA	-	3.8 (0.7)	3.3 (0.6)	3.5 (0.6)	5.9 (1.4)	3.8 (0.9)	4.2 (1.1)	-	53.0 (1.8)	53.2 (1.7)	50.5 (1.6)	47.3 (3.0)	53.4 (2.5)	44.5 (2.6)
HI	6.1 (0.7)	6.0 (0.5)	5.9 (0.6)	5.2 (0.5)	5.4 (0.5)	5.3 (0.5)	3.9 (0.6)	57.0 (1.4)	58.3 (1.1)	58.2 (1.2)	59.0 (1.2)	56.0 (1.2)	55.9 (1.2)	57.1 (1.6)
IL	4.2 (0.6)	4.2 (0.5)	3.8 (0.5)	4.0 (0.5)	4.0 (0.5)	4.0 (0.5)	3.7 (0.5)	53.8 (1.4)	55.2 (1.3)	52.6 (1.4)	52.9 (1.4)	53.1 (1.4)	54.1 (1.4)	50.0 (1.4)
LA	6.7 (0.7)	5.3 (0.6)	-	-	-	-	-	55.8 (1.4)	50.4 (1.4)	-	-	-	-	-
ME	4.1 (0.7)	3.3 (0.6)	3.3 (0.36)	4.3 (0.7)	3.2 (0.6)	3.6 (0.6)	3.2 (0.6)	55.1 (1.7)	53.9 (1.7)	50.4 (1.7)	51.9 (1.7)	53.5 (1.7)	51.0 (1.7)	50.6 (1.8)
MD	4.1 (0.8)	5.3 (0.9)	2.6 (0.7)	3.8 (0.8)	3.6 (0.7)	3.8 (0.7)	3.0 (0.7)	53.4 (2.0)	52.3 (2.0)	53.9 (2.2)	51.9 (1.9)	56.1 (1.9)	53.5 (1.9)	53.3 (2.0)
MA	-	-		-	4.2 (0.7)	5.0 (0.8)	2.8 (0.6)	-	-	-	-	59.0 (1.8)	55.6 (1.8)	57.3 (1.8)
MI	5.8 (0.7)	5.2 (0.8)	3.1 (0.5)	4.7 (0.7)	2.7 (0.5)	2.4 (0.5)	3.0 (0.5)	49.9 (1.5)	48.5 (1.6)	50.5 (1.6)	48.7 (1.8)	50.8 (1.5)	49.9 (1.5)	51.4 (1.5)
MN	3.5 (0.6)	4.0 (0.7)	3.3 (0.6)	4.0 (0.5)	4.1 (0.6)	2.7 (0.5)	2.3 (0.4)	58.9 (1.5)	57.4 (1.7)	53.4 (1.7)	52.3 (1.3)	53.4 (1.4)	53.5 (1.5)	53.2 (1.5)
MS	5.3 (0.8)	5.4 (0.8)	-	4.4 (0.8)	-	5.5 (0.8)	5.2 (0.8)	48.9 (1.7)	50.6 (1.7)	-	47.4 (2.1)	-	46.6 (1.7)	45.1 (1.7)

MO	-	-	-	-	4.4	-	4.7	-	-	-	-	51.8	-	48.6
					(0.7)		(0.8)					(1.7)		(1.7)
NE	2.9	4.4	3.9	4.4	3.9	3.9	3.4	57.9	55.2	52.9	52.8	54.0	50.5	51.5
	(0.4)	(0.6)	(0.6)	(0.7)	(0.6)	(0.6)	(0.5)	(1.4)	(1.4)	(1.4)	(1.6)	(1.6)	(1.6)	(1.5)
NJ	5.2	4.1	4.0	4.9	3.0	2.8	4.2	60.6	57.6	55.4	57.7	59.1	54.0	54.6
	(0.6)	(0.5)	(0.5)	(0.5)	(0.5)	(0.4)	(0.6)	(1.2)	(1.3)	(1.3)	(1.3)	(1.4)	(1.5)	(1.5)
NM	4.0	3.6	3.5	-	-	-	-	55.3	53.3	53.4	-	-	-	-
	(0.6)	(0.5)	(0.6)					(1.5)	(1.4)	(1.7)				
NY	4.2	2.8	3.8	2.7	3.5	3.7	-	57.9	57.6	53.4	55.8	52.8	52.3	-
	(0.8)	(0.6)	(0.7)	(0.9)	(0.7)	(0.7)		(1.8)	(2.0)	(1.9)	(2.7)	(2.0)	(2.0)	
NYC	-	6.5	6.3	5.8	5.8	-	-	-	54.6	55.8	58.8	58.0	-	-
		(1.2)	(1.0)	(0.8)	(0.9)				(2.4)	(2.1)	(1.7)	(1.7)		
NC	3.8	5.3	4.8	-	3.8	3.8	-	51.1	52.1	49.8	-	53.2	52.8	-
	(0.6)	(0.7)	(0.9)		(0.6)	(0.6)		(1.7)	(1.7)	(2.0)		(1.6)	(1.6)	
OH	6.1	-	4.2	4.2	4.8	4.1	4.1	50.2	-	53.2	49.8	51.4	51.6	47.1
	(0.9)		(0.7)	(0.7)	(0.8)	(0.7)	(0.8)	(1.8)		(1.9)	(1.7)	(1.8)	(1.8)	(1.8)
OK	6.0	4.0	4.2	4.4	4.0	5.3	4.1	52.6	55.2	53.3	48.3	52.5	50.8	49.3
	(0.9)	(0.8)	(0.7)	(0.8)	(0.7)	(0.9)	(0.8)	(1.9)	(1.9)	(1.9)	(1.9)	(2.0)	(1.9)	(1.9)
OR	3.8	3.5	2.4	3.5	3.5	3.6	2.9	56.7	54.6	56.7	51.8	49.4	53.3	52.9
	(0.8)	(0.6)	(0.5)	(0.7)	(0.6)	(0.8)	(0.6)	(2.1)	(1.9)	(1.9)	(1.9)	(2.0)	(2.0)	(1.9)
PA	-	-	-	-	4.0	4.6	4.3	-	-	-	-	53.2	53.9	51.6
					(1.1)	(0.7)	(0.7)					(1.6)	(1.7)	(1.8)
RI	4.3	3.4	4.9	3.4	3.7	3.9	4.2	56.7	56.6	56.2	54.0	55.3	55.0	50.7
	(0.6)	(0.6)	(0.7)	(0.6)	(0.6)	(0.6)	(0.7)	(1.6)	(1.6)	(1.6)	(1.7)	(1.6)	(1.7)	(1.7)
SC	6.0	5.1	5.9	3.7	3.7	-	-	49.5	50.6	48.9	54.3	48.6	-	-
	(1.0)	(0.9)	(1.0)	(1.1)	(0.8)			(2.2)	(2.1)	(2.1)	(3.0)	(2.2)		
TN	-	-	-	-	-	3.5	4.7	-	-	-	-	-	48.8	50.3
						(0.9)	(1.1)						(2.5)	(2.5)
TX	-	-	-	-	-		3.9	-	-	-	-	-		47.1
							(0.6)							(1.6)
UT	5.2	5.3	4.9	5.0	5.5	4.5	4.9	60.2	61.7	57.3	58.8	59.3	58.4	55.9
	(0.7)	(0.6)	(0.6)	(0.6)	(0.6)	(0.6)	(0.6)	(1.6)	(1.3)	(1.4)	(1.3)	(1.3)	(1.3)	(1.4)
VT	3.5	3.7	4.4	3.1	3.6	3.6	3.0	55.9	59.0	54.1	53.8	55.1	52.6	54.0
	(0.5)	(0.6)	(0.7)	(0.5)	(0.6)	(0.6)	(0.5)	(1.4)	(1.5)	(1.6)	(1.5)	(1.5)	(1.6)	(1.6)
WA	4.8	3.7	3.9	3.8	5.0	2.6	2.6	55.9	51.7	57.4	52.9	51.9	57.9	51.0
	(0.8)	(0.7)	(0.7)	(0.7)	(0.8)	(0.5)	(0.6)	(1.9)	(1.8)	(1.8)	(1.8)	(1.8)	(1.7)	(1.8)
WV	7.4	5.5	5.7	6.7	6.0	6.4	5.6	51.3	51.5	47.2	45.8	46.5	45.8	45.9
	(0.9)	(1.1)	(0.8)	(0.8)	(0.8)	(0.7)	(0.7)	(1.8)	(1.5)	(1.8)	(1.8)	(1.7)	(1.5)	(1.6)
WI	-	-	-	-	3.4	3.7	4.3	-	-	-	-	51.8	50.4	51.4
					(0.7)	(0.7)	(0.8)					(1.9)	(1.9)	(1.9)
WY	-	-	-	-	4.1	4.6	4.9	-	-	-	-	52.5	51.2	53.3
					(0.8)	(0.8)	(0.9)					(1.9)	(1.9)	(2.0)

Maternal Age[a]														
<20	4.3 (0.6)	5.5 (0.8)	2.5 (0.4)	4.7 (0.7)	5.0 (0.7)	3.9 (0.6)	3.9 (0.6)	70.9 (1.5)	69.6 (1.6)	70.7 (1.6)	68.6 (1.5)	68.1 (1.5)	68.4 (1.5)	69.5 (1.5)
20-24	6.9 (0.5)	6.5 (0.5)	6.3 (0.5)	6.4 (0.5)	5.5 (0.4)	5.6 (0.4)	5.0 (0.4)	53.9 (1.0)	51.7 (1.0)	52.6 (1.0)	50.6 (1.0)	51.8 (1.0)	51.2 (1.0)	50.0 (1.0)
25-29	5.1 (0.4)	4.4 (0.4)	4.0 (0.3)	4.1 (0.3)	3.7 (0.3)	3.5 (0.3)	3.6 (0.3)	51.9 (0.9)	52.1 (0.9)	50.9 (0.9)	50.3 (0.9)	51.5 (0.9)	51.3 (0.9)	50.1 (0.9)
30-34	3.5 (0.4)	3.4 (0.3)	2.6 (0.3)	3.5 (0.3)	3.3 (0.3)	2.5 (0.3)	3.0 (0.3)	56.3 (0.9)	54.1 (0.9)	54.0 (1.0)	54.1 (0.9)	52.9 (0.9)	55.1 (0.9)	51.9 (0.9)
≥35	3.0 (0.4)	2.9 (0.4)	2.7 (0.4)	2.9 (0.4)	2.5 (0.3)	2.4 (0.3)	2.2 (0.4)	53.9 (1.2)	55.8 (1.2)	52.6 (1.2)	50.8 (1.1)	53.1 (1.1)	50.0 (1.2)	50.4 (1.2)
Maternal Race-Ethnicity[a]														
Non-Hispanic White	4.7 (0.2)	4.6 (0.3)	3.9 (0.2)	4.2 (0.2)	3.9 (0.2)	3.6 (0.2)	3.5 (0.2)	57.7 (0.6)	56.8 (0.6)	56.1 (0.6)	54.5 (0.6)	55.7 (0.6)	55.3 (0.6)	54.3 (0.6)
Non-Hispanic Black	2.6 (0.5)	3.3 (0.5)	3.1 (0.5)	4.2 (0.6)	2.4 (0.4)	2.4 (0.4)	3.3 (0.5)	44.4 (1.5)	40.9 (1.5)	41.7 (1.5)	40.3 (1.4)	42.6 (1.3)	42.5 (1.4)	41.3 (1.4)
Hispanic	4.1 (0.5)	3.5 (0.5)	2.8 (0.4)	4.0 (0.5)	3.3 (0.5)	3.4 (0.4)	2.3 (0.4)	51.1 (1.3)	50.6 (1.3)	51.6 (1.3)	51.0 (1.2)	49.6 (1.2)	51.4 (1.2)	48.5 (1.2)
American Indian/ Alaskan Native	3.2 (0.9)	2.3 (0.7)	2.1 (0.6)	2.8 (1.0)	1.9 (0.6)	2.2 (0.9)	5.4 (1.7)	47.1 (2.6)	48.3 (2.9)	48.9 (2.8)	42.2 (1.9)	50.3 (2.9)	40.7 (2.8)	42.6 (2.8)
Asian/Pacific Islander	10.1 (1.0)	8.5 (0.9)	8.1 (0.8)	8.4 (0.9)	8.9 (1.0)	7.5 (0.8)	7.0 (0.9)	64.5 (1.5)	67.1 (1.4)	62.9 (1.5)	65.9 (1.4)	64.4 (1.5)	65.5 (1.4)	63.2 (1.5)
Other	12.4 (5.5)	7.8 (2.9)	5.5 (2.0)	4.4 (1.5)	3.4 (1.4)	2.4 (0.8)	4.7 (1.4)	43.6 (6.6)	60.9 (5.4)	54.9 (4.8)	65.3 (3.8)	49.4 (4.3)	54.5 (3.5)	55.9 (3.0)

[a]Includes only states with data for all time points (18 states)

[b]States with data for all time points (18 states), standardized by age and race-ethnicity

Appendix Table 2 (continued). Pre-pregnancy BMI, by State, 2003-2009. Values are percent (standard error).

	Overweight							Obese							P-trend (Obesity)
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	
Overall – Crude[a]	23.3 (0.4)	23.2 (0.4)	22.9 (0.4)	23.6 (0.4)	24.1 (0.4)	23.7 (0.4)	24.3 (0.4)	16.5 (0.4)	17.7 (0.4)	19.2 (0.4)	19.1 (0.4)	18.3 (0.4)	19.1 (0.4)	19.9 (0.4)	<0.001
Overall – Standardized[b]	23.4 (0.4)	23.3 (0.4)	23.0 (0.4)	23.5 (0.4)	24.1 (0.4)	23.7 (0.4)	24.2 (0.4)	16.6 (0.4)	17.6 (0.4)	19.0 (0.4)	19.1 (0.4)	18.3 (0.4)	19.0 (0.4)	19.9 (0.4)	<0.001

State															
AL	22.0 (1.4)	-	-	-	-	-	-	21.1 (1.4)	-	-	-	-	-	-	-
AK	27.2 (1.3)	24.3 (1.5)	24.4 (1.4)	26.1 (1.5)	25.2 (1.5)	24.5 (1.5)	27.7 (1.6)	19.0 (1.2)	18.4 (1.3)	20.6 (1.4)	19.9 (1.3)	21.5 (1.4)	19.9 (1.4)	21.4 (1.5)	0.11
AR	23.5 (1.4)	23.5 (1.3)	22.1 (1.3)	24.7 (1.3)	25.2 (1.4)	25.0 (1.5)	23.1 (1.7)	20.8 (1.3)	22.1 (1.3)	21.7 (1.2)	22.3 (1.3)	21.7 (1.4)	22.3 (1.4)	25.5 (1.8)	0.06
CO	22.5 (1.2)	22.4 (1.4)	22.1 (1.5)	21.0 (1.3)	24.2 (1.4)	23.7 (1.4)	22.6 (1.4)	11.5 (0.9)	13.5 (1.2)	14.0 (1.2)	18.6 (1.4)	16.7 (1.3)	14.3 (1.1)	13.8 (1.1)	0.05
DE	-	-	-	-	23.5 (1.7)	25.2 (1.3)	23.5 (1.4)	-	-	-	-	22.9 (1.8)	22.4 (1.3)	23.5 (1.4)	
FL	21.8 (1.4)	22.5 (1.4)	20.1 (1.2)	-	-	-	-	18.8 (1.3)	15.6 (1.1)	17.2 (1.2)	-	-	-	-	-
GA	-	22.9 (1.5)	25.2 (1.5)	24.7 (1.4)	26.9 (2.6)	23.3 (2.1)	31.1 (2.4)	-	20.3 (1.4)	18.4 (1.3)	21.3 (1.3)	19.9 (2.4)	19.5 (2.0)	20.2 (2.0)	-
HI	21.7 (1.1)	19.8 (0.9)	20.3 (1.0)	21.8 (1.1)	22.3 (1.0)	22.2 (1.0)	21.9 (1.4)	15.3 (1.0)	15.9 (0.8)	15.7 (0.9)	14.1 (0.9)	16.4 (0.9)	16.6 (0.9)	17.1 (1.3)	0.17
IL	24.4 (1.2)	24.0 (1.1)	23.1 (1.2)	23.8 (1.2)	24.6 (1.2)	23.0 (1.2)	26.1 (1.3)	17.6 (1.1)	16.7 (1.0)	20.6 (1.2)	19.3 (1.1)	18.4 (1.1)	18.9 (1.1)	20.2 (1.1)	0.08
LA	20.4 (1.2)	22.8 (1.2)	-	-	-	-	-	17.1 (1.1)	21.5 (1.2)	-	-	-	-	-	-
ME	21.0 (1.4)	23.8 (1.4)	23.7 (1.4)	22.5 (1.4)	23.0 (1.5)	22.7 (1.4)	24.7 (1.6)	19.8 (1.4)	19.0 (1.3)	22.7 (1.4)	21.3 (1.4)	20.3 (1.4)	22.7 (1.4)	21.5 (1.5)	0.18
MD	25.8 (1.7)	23.6 (1.6)	25.2 (1.9)	24.2 (1.7)	25.2 (1.7)	24.3 (1.7)	21.9 (1.6)	16.4 (1.5)	18.9 (1.6)	18.3 (1.7)	20.1 (1.6)	15.2 (1.4)	18.5 (1.5)	21.9 (1.6)	0.17
MA	-	-		-	23.2 (1.5)	20.2 (1.4)	21.4 (1.5)	-	-	-	-	13.7 (1.3)	19.3 (1.4)	18.4 (1.5)	-
MI	25.8 (1.3)	24.0 (1.4)	22.9 (1.4)	24.6 (1.5)	24.5 (1.3)	24.5 (1.3)	23.9 (1.3)	18.5 (1.2)	22.3 (1.4)	23.6 (1.4)	22.1 (1.5)	22.0 (1.2)	23.2 (1.3)	21.8 (1.2)	0.10
MN	20.6 (1.3)	21.4 (1.4)	23.6 (1.4)	26.3 (1.2)	24.9 (1.3)	24.5 (1.3)	26.7 (1.3)	17.0 (1.2)	17.2 (1.3)	19.7 (1.3)	17.4 (1.0)	17.6 (1.1)	18.4 (1.1)	17.9 (1.2)	0.62
MS	24.0 (1.5)	21.7 (1.4)	-	22.1 (1.7)	-	21.2 (1.4)	22.0 (1.4)	21.8 (1.4)	22.4 (1.4)	-	26.2 (1.8)	-	26.8 (1.5)	27.7 (1.5)	-
MO	-	-	-	-	21.9 (1.4)	-	23.9 (1.4)	-	-	-	-	22.0 (1.4)	-	22.8 (1.4)	-
NE	23.3 (1.2)	22.9 (1.2)	23.0 (1.2)	23.6 (1.3)	23.6 (1.4)	25.8 (1.4)	24.1 (1.2)	15.9 (1.0)	17.5 (1.1)	20.2 (1.2)	19.2 (1.3)	18.5 (1.2)	19.8 (1.3)	21.0 (1.2)	0.00
NJ	21.2 (1.0)	23.4 (1.1)	24.7 (1.1)	21.7 (1.1)	22.5 (1.2)	25.6 (1.3)	23.2 (1.3)	13.0 (0.9)	14.9 (0.9)	16.0 (0.9)	15.8 (0.9)	15.4 (1.0)	17.7 (1.1)	18.0 (1.1)	0.00
NM	21.3 (1.2)	23.6 (1.2)	23.5 (1.4)	-	-	-	-	19.4 (1.2)	19.5 (1.1)	19.5 (1.3)	-	-	-	-	-
NY	20.0 (1.5)	22.6 (1.7)	21.6 (1.6)	22.7 (2.3)	26.2 (1.8)	25.1 (1.7)	-	17.9 (1.4)	17.1 (1.5)	21.2 (1.6)	18.9 (2.1)	17.6 (1.5)	18.9 (1.5)	-	-

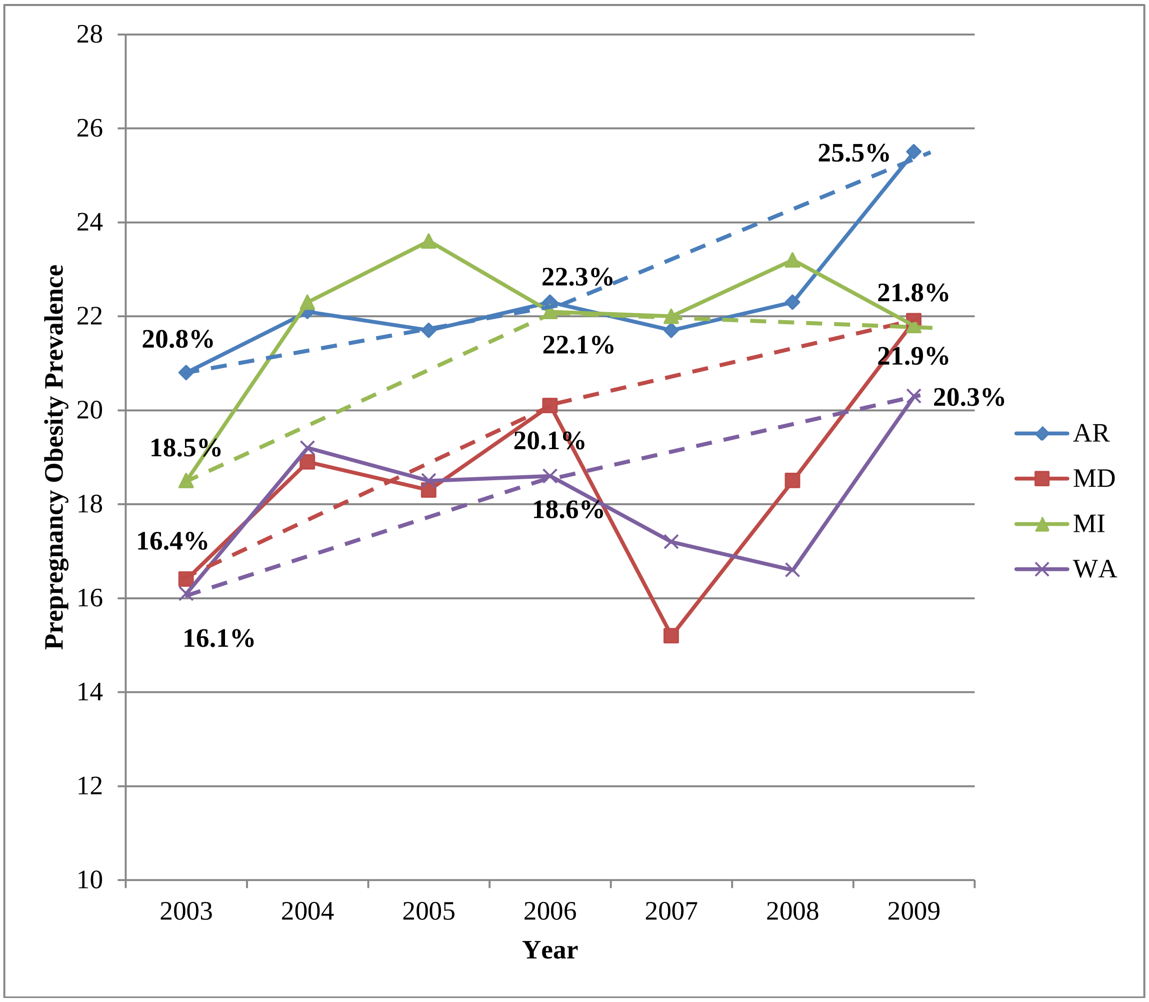
NYC	-	24.3 (2.0)	22.9 (1.8)	21.2 (1.4)	20.3 (1.4)	-	-	-	14.5 (1.7)	15.1 (1.5)	14.2 (1.2)	15.9 (1.3)	-	-	-
NC	23.8 (1.5)	22.6 (1.4)	24.6 (1.8)	-	23.3 (1.4)	22.8 (1.4)	-	21.3 (1.4)	20.2 (1.3)	20.8 (1.6)	-	19.7 (1.3)	20.6 (1.3)	-	-
OH	20.1 (1.4)	-	21.0 (1.5)	25.7 (1.5)	23.9 (1.5)	22.4 (1.5)	25.3 (1.6)	23.6 (1.5)	-	21.5 (1.5)	20.3 (1.4)	19.9 (1.4)	21.9 (1.4)	23.5 (1.6)	-
OK	24.6 (1.6)	20.9 (1.6)	22.7 (1.6)	24.6 (1.7)	21.9 (1.6)	20.9 (1.6)	22.9 (1.6)	16.8 (1.4)	19.9 (1.5)	19.8 (1.5)	22.7 (1.6)	21.7 (1.6)	23.0 (1.6)	23.7 (1.6)	<0.001
OR	21.5 (1.7)	24.4 (1.7)	23.5 (1.6)	22.1 (1.6)	27.8 (1.8)	21.9 (1.7)	24.3 (1.6)	18.0 (1.6)	17.5 (1.5)	17.4 (1.4)	22.6 (1.6)	19.3 (1.6)	21.3 (1.7)	19.9 (1.6)	0.08
PA	-	-	-	-	20.7 (2.2)	24.6 (1.5)	22.0 (1.5)	-	-	-	-	22.1 (2.2)	16.9 (1.3)	22.0 (1.5)	-
RI	22.2 (1.3)	23.0 (1.4)	24.0 (1.4)	24.3 (1.4)	25.2 (1.4)	23.5 (1.5)	26.66 (1.5)	16.8 (1.2)	17.1 (1.2)	14.9 (1.1)	18.2 (1.3)	15.8 (1.2)	17.7 (1.3)	18.4 (1.3)	0.31
SC	22.6 (1.8)	24.1 (1.8)	22.7 (1.8)	19.5 (2.3)	22.3 (1.8)	-	-	22.0 (1.8)	20.2 (1.7)	22.5 (1.7)	22.6 (2.5)	25.4 (1.9)	-	-	-
TN	-	-	-	-	-	25.5 (2.2)	23.2 (2.1)	-	-	-	-	-	22.1 (2.1)	21.8 (2.0)	-
TX	-	-	-	-	-	-	24.6 (1.4)	-	-	-	-	-	-	24.3 (1.4)	-
UT	20.5 (1.3)	21.1 (1.1)	22.0 (1.1)	22.5 (1.2)	19.8 (1.1)	22.9 (1.2)	22.9 (1.2)	14.2 (1.1)	11.9 (0.8)	15.8 (1.0)	13.7 (0.9)	15.4 (1.0)	14.2 (0.9)	16.2 (1.1)	0.06
VT	22.0 (1.2)	19.9 (1.2)	21.3 (1.3)	23.7 (1.3)	22.0 (1.3)	21.8 (1.3)	23.3 (1.3)	18.7 (1.1)	17.5 (1.2)	20.2 (1.3)	19.5 (1.2)	19.4 (1.2)	22.0 (1.3)	19.7 (1.3)	0.08
WA	23.2 (1.6)	25.4 (1.6)	20.2 (1.5)	24.7 (1.5)	25.9 (1.6)	22.9 (1.5)	26.1 (1.6)	16.1 (1.4)	19.2 (1.5)	18.5 (1.4)	18.6 (1.4)	17.2 (1.4)	16.6 (1.3)	20.3 (1.5)	0.41
WV	19.9 (1.4)	19.9 (2.0)	23.0 (1.5)	23.5 (1.5)	23.1 (1.5)	22.7 (1.3)	23.2 (1.3)	21.3 (1.5)	23.0 (2.1)	24.2 (1.5)	24.05 (1.5)	24.5 (1.5)	25.1 (1.3)	25.2 (1.4)	0.04
WI	-	-	-	-	26.4 (1.6)	22.5 (1.6)	24.6 (1.7)	-	-	-	-	18.5 (1.4)	23.4 (1.7)	19.7 (1.5)	-
WY	-	-	-	-	25.2 (1.6)	24.7 (1.6)	21.2 (1.6)	-	-	-	-	18.2 (1.4)	19.5 (1.5)	20.5 (1.6)	-
Maternal Age[a]															
<20	16.9 (1.3)	15.7 (1.2)	16.2 (1.3)	16.0 (1.2)	17.4 (1.3)	18.6 (1.2)	16.0 (1.2)	7.9 (0.9)	9.2 (1.0)	10.6 (1.1)	10.8 (1.1)	9.5 (0.9)	9.1 (0.9)	10.6 (1.0)	0.19
20-24	22.8 (0.8)	24.3 (0.8)	23.4 (0.8)	22.9 (0.8)	23.9 (0.8)	22.9 (0.8)	24.4 (0.9)	16.3 (0.7)	17.6 (0.8)	17.8 (0.8)	20.2 (0.8)	18.8 (0.8)	20.3 (0.8)	20.7 (0.8)	<0.001
25-29	24.3 (0.8)	24.6 (0.8)	23.1 (0.7)	25.0 (0.7)	25.1 (0.7)	24.2 (0.7)	25.5 (0.8)	18.7 (0.7)	18.8 (0.7)	21.9 (0.8)	20.7 (0.7)	19.9 (0.7)	21.0 (0.7)	20.8 (0.7)	0.02
30-34	23.4 (0.8)	23.1 (0.8)	23.3 (0.8)	23.7 (0.8)	24.9 (0.8)	24.5 (0.8)	24.7 (0.8)	16.9 (0.7)	19.4 (0.8)	20.1 (0.8)	18.7 (0.7)	18.9 (0.7)	18.0 (0.7)	20.4 (0.8)	0.08

≥35	25.8 (1.1)	23.4 (1.0)	25.2 (1.0)	26.4 (1.0)	25.6 (1.0)	26.0 (1.0)	25.6 (1.0)	17.4 (0.9)	17.9 (0.9)	19.6 (1.0)	20.0 (0.9)	18.9 (0.9)	21.6 (1.0)	21.8 (1.0)	0.00
Maternal Race-Ethnicity[a]															
Non-Hispanic White	22.2 (0.5)	21.6 (0.5)	21.6 (0.5)	22.9 (0.5)	23.4 (0.5)	23.1 (0.5)	23.4 (0.5)	15.4 (0.4)	17.0 (0.4)	18.4 (0.5)	18.5 (0.5)	17.0 (0.4)	17.9 (0.4)	18.8 (0.5)	<0.001
Non-Hispanic Black	27.8 (1.4)	30.4 (1.4)	26.9 (1.4)	28.4 (1.3)	28.3 (1.2)	26.8 (1.3)	25.9 (1.3)	25.3 (1.3)	25.5 (1.3)	28.3 (1.4)	27.2 (1.3)	26.8 (1.2)	28.4 (1.3)	29.5 (1.3)	0.02
Hispanic	27.3 (1.1)	28.0 (1.1)	27.1 (1.1)	25.5 (1.1)	26.3 (1.1)	26.3 (1.1)	27.9 (1.1)	17.5 (1.0)	17.9 (1.0)	18.5 (1.0)	19.6 (1.0)	20.8 (1.0)	18.9 (0.9)	21.3 (1.0)	0.00
American Indian/ Alaskan Native	27.2 (2.4)	24.7 (2.5)	25.0 (2.4)	26.7 (2.6)	22.3 (2.5)	29.3 (2.6)	26.6 (2.5)	22.6 (2.0)	24.7 (2.5)	24.0 (2.4)	28.4 (2.6)	25.5 (2.3)	27.8 (2.5)	25.5 (2.4)	0.18
Asian/Pacific Islander	17.0 (1.2)	16.8 (1.1)	20.1 (1.3)	17.0 (1.0)	18.6 (1.2)	16.6 (1.1)	21.4 (1.4)	8.3 (0.8)	7.5 (0.7)	8.9 (0.7)	8.6 (0.8)	8.1 (0.7)	10.5 (0.8)	8.5 (0.7)	0.16
Other	27.6 (5.9)	19.7 (4.6)	22.7 (4.1)	21.6 (3.3)	27.5 (4.1)	21.4 (2.7)	21.7 (2.4)	16.4 (5.0)	11.6 (3.4)	17.0 (3.5)	8.7 (2.0)	19.7 (3.5)	21.8 (3.2)	17.7 (2.4)	0.08

[a]Includes only states with data for all time points (18 states)

[b]Includes only states with data for all time points (18 states), standardized by age and race-ethnicity

Appendix Figure 1. Prepregnancy obesity trends by state, 2003-2009. Solid lines indicate the actual trend based on seven time points. Dotted lines indicate the trend estimate with only three time points (2003, 2006, 2009). Arkansas, Maryland, Michigan, and Washington are the four states with available data that had significantly increasing prepregnancy obesity trends based on the three-year analysis, but insignificant trends based on the seven-year analysis.



Appendix Table 3. Prepregnancy obesity prevalence among women ≥20 years by obesity severity and state, 2003-2009. Values are weighted percent (standard error).

	Class I Obesity							
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**p-trend**
Overall[a]	10.1 (0.3)	10.8 (0.3)	11.4 (0.3)	11.6 (0.3)	10.9 (0.3)	11.9 (0.3)	11.8 (0.3)	0.0000
Overall[b]	9.3 (0.3)	9.8 (0.3)	10.3 (0.3)	10.6 (0.3)	10.0 (0.3)	10.8 (0.3)	10.7 (0.3)	0.0001
State								
AL	13.0 (1.2)	-	-	-	-	-	-	-
AK	10.8 (1.0)	11.8 (1.1)	12.0 (1.1)	11.6 (1.1)	15.4 (1.3)	12.5 (1.2)	12.4 (1.2)	0.12
AR	12.4 (1.2)	13.5 (1.2)	10.5 (1.0)	11.8 (1.1)	13.6 (1.2)	13.2 (1.2)	15.4 (1.6)	0.09
CO	7.3 (0.8)	9.6 (1.1)	9.7 (1.1)	11.0 (1.1)	11.4 (1.1)	10.7 (1.1)	7.7 (0.9)	0.29
DE	-	-	-	-	13.1 (1.5)	11.1 (1.0)	12.4 (1.1)	-
FL	14.0 (1.3)	9.8 (1.0)	10.3 (1.0)	-	-	-	-	-
GA	-	11.8 (1.2)	11.1 (1.1)	11.1 (1.1)	13.3 (2.1)	10.0 (1.6)	10.6 (1.6)	-
HI	9.8 (0.8)	9.9 (0.7)	10.9 (0.8)	9.8 (0.8)	9.6 (0.8)	9.5 (0.8)	11.7 (1.1)	0.49
IL	10.9 (1.0)	11.1 (0.9)	11.7 (1.0)	12.7 (1.0)	10.9 (0.9)	12.0 (1.0)	12.6 (1.0)	0.25
LA	9.5 (0.9)	12.3 (1.0)	-	-	-	-	-	-
ME	10.6 (1.1)	11.7 (1.1)	13.5 (1.2)	12.8 (1.2)	12.1 (1.1)	14.2 (1.3)	11.8 (1.2)	0.27
MD	8.3 (1.1)	9.7 (1.2)	11.0 (1.4)	11.3 (1.3)	9.6 (1.2)	13.4 (1.4)	13.1 (1.4)	0.00
MA	-	-	-	-	8.2 (1.0)	12.3 (1.2)	9.7 (1.1)	-
MI	11.2 (1.0)	12.5 (1.1)	12.2 (1.1)	12.3 (1.2)	11.5 (1.0)	13.4 (1.1)	12.2 (1.0)	0.41
MN	10.4 (1.0)	10.1 (1.1)	12.2 (1.1)	10.7 (0.8)	11.4 (0.9)	10.8 (0.9)	11.9 (1.0)	0.33
MS	13.1 (1.2)	13.1 (1.3)	-	12.7 (1.5)	-	14.6 (1.3)	16.7 (1.4)	-
MO	-	-	-	-	13.9 (1.2)	-	12.6 (1.2)	-
NE	10.2 (0.9)	12.1 (1.0)	12.6 (1.0)	12.8 (1.1)	10.2 (1.0)	13.0 (1.1)	12.6 (1.0)	0.22
NJ	8.6 (0.7)	10.2 (0.8)	10.6 (0.8)	9.8 (0.8)	9.6 (0.9)	10.7 (0.9)	11.5 (1.0)	0.05
NM	14.6 (1.2)	14.4 (1.1)	12.7 (1.2)	-	-	-	-	-
NY	12.9 (1.3)	12.4 (1.4)	11.8 (1.3)	13.0 (1.9)	9.9 (1.2)	10.9 (1.2)	-	-
NYC	-	8.2 (1.4)	8.9 (1.2)	9.2 (1.0)	10.0 (1.1)	-	-	-
NC	12.2 (1.2)	11.4 (1.1)	12.2 (1.4)	-	10.7 (1.1)	12.1 (1.1)	-	-
OH	13.9 (1.3)	-	12.3 (1.3)	12.6 (1.2)	11.9 (1.2)	12.4 (1.2)	11.3 (1.2)	-
OK	11.6 (1.3)	12.0 (1.3)	11.7 (1.3)	12.8 (1.3)	12.8 (1.4)	13.5 (1.4)	14.2 (1.4)	0.09
OR	11.1 (0.3)	9.0 (1.1)	12.4 (1.3)	12.4 (1.3)	11.8 (1.3)	14.4 (1.5)	11.6 (1.3)	0.09
PA	-	-	-	-	13.4 (1.9)	10.5 (1.1)	13.3 (1.3)	-
RI	10.6 (1.0)	11.5 (1.1)	7.6 (0.9)	11.2 (1.1)	9.7 (1.0)	9.9 (1.1)	11.7 (1.1)	0.74
SC	11.5 (1.5)	14.0 (1.6)	14.1 (1.5)	14.3 (2.3)	12.5 (1.5)	-	-	-
TN	-	-	-	-	-	12.5 (1.8)	10.4 (1.6)	-
TX	-	-	-	-	-	-	15.2 (1.3)	-
UT	10.3 (1.0)	7.5 (0.7)	10.3 (0.8)	9.5 (0.8)	10.2 (0.8)	8.6 (0.8)	9.0 (0.9)	0.73

VT	12.1 (1.0)	9.3 (1.0)	11.1 (1.0)	13.1 (1.1)	9.8 (0.9)	13.8 (1.1)	10.1 (1.0)	0.72
WA	9.1 (1.1)	11.7 (1.3)	11.2 (1.2)	12.1 (1.2)	9.6 (1.1)	11.1 (1.2)	10.8 (1.1)	0.72
WV	12.9 (1.4)	13.1 (1.9)	15.3 (1.4)	14.0 (1.4)	13.2 (1.3)	13.3 (1.1)	14.4 (1.2)	0.77
WI	-	-	-	-	9.5 (1.1)	14.1 (1.4)	11.4 (1.3)	-
WY	-	-	-	-	14.0 (1.4)	12.4 (1.3)	13.4 (1.4)	-

[a]Includes only states with data for all time points (18 states)

[b]Includes only states with data for all time points (18 states), standardized by age and race-ethnicity

Appendix Table 3 (continued).

	Class II Obesity							
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**p-trend**
Overall[a]	4.4 (0.2)	4.7 (0.2)	5.1 (0.2)	5.1 (0.2)	4.7 (0.2)	4.6 (0.2)	5.3 (0.2)	0.04
Overall[b]	4.0 (0.2)	4.2 (0.2)	4.5 (0.2)	4.6 (0.2)	4.2 (0.2)	4.2 (0.2)	4.8 (0.2)	0.03
State								
AL	6.8 (0.9)	-	-	-	-	-	-	-
AK	5.6 (0.7)	4.0 (0.7)	4.9 (0.7)	5.9 (0.8)	3.9 (0.6)	5.9 (0.9)	6.6 (0.9)	0.17
AR	6.0 (0.8)	5.9 (0.7)	5.9 (0.7)	6.8 (0.8)	4.5 (0.7)	6.5 (0.9)	8.5 (1.2)	0.15
CO	2.9 (0.5)	3.2 (0.6)	3.6 (0.7)	4.4 (0.8)	4.0 (0.7)	3.0 (0.5)	4.2 (0.6)	0.18
DE	-	-	-	-	5.4 (1.0)	7.6 (0.9)	6.3 (0.8)	-
FL	3.6 (0.6)	4.2 (0.7)	4.3 (0.7)	-	-	-	-	-
GA	-	5.9 (0.9)	4.8 (0.8)	7.2 (0.9)	5.7 (1.5)	4.8 (1.1)	7.2 (1.5)	-
HI	3.9 (0.6)	4.3 (0.5)	3.6 (0.5)	3.8 (0.5)	5.2 (0.6)	4.3 (0.5)	4.2 (0.7)	0.40
IL	4.5 (0.6)	4.0 (0.5)	5.3 (0.7)	4.6 (0.6)	4.6 (0.6)	3.5 (0.6)	5.2 (0.7)	0.86
LA	6.0 (0.7)	6.1 (0.8)	-	-	-	-	-	-
ME	6.1 (0.8)	5.4 (0.8)	6.3 (0.9)	6.0 (0.8)	5.7 (0.8)	5.7 (0.8)	4.9 (0.8)	0.44
MD	5.3 (0.9)	6.5 (1.1)	4.4 (1.0)	6.9 (1.1)	3.0 (0.6)	3.7 (0.7)	5.3 (0.9)	0.14
MA	-	-	-	-	3.1 (0.7)	5.3 (0.9)	6.8 (1.0)	-
MI	4.7 (0.7)	6.0 (0.8)	7.8 (0.9)	6.1 (0.8)	6.5 (0.7)	5.8 (0.7)	6.1 (0.7)	0.50
MN	4.4 (0.7)	5.3 (0.8)	6.5 (0.9)	5.2 (0.6)	4.0 (0.6)	5.2 (0.7)	4.1 (0.6)	0.26
MS	6.9 (0.9)	5.0 (0.8)	-	8.9 (1.3)	-	8.5 (1.1)	7.4 (1.0)	-
MO	-	-	-	-	5.8 (0.8)	-	6.3 (0.9)	-
NE	4.7 (0.6)	4.2 (0.6)	5.2 (0.7)	5.1 (0.8)	5.8 (0.8)	4.4 (0.7)	5.6 (0.7)	0.27
NJ	3.0 (0.5)	3.4 (0.5)	3.0 (0.4)	4.6 (0.6)	3.6 (0.6)	4.6 (0.6)	3.6 (0.6)	0.08
NM	4.7 (0.7)	5.0 (0.7)	6.8 (0.9)	-	-	-	-	-
NY	3.5 (0.7)	3.6 (0.8)	6.6 (1.0)	3.4 (1.0)	4.4 (0.8)	5.6 (0.9)	-	-
NYC	-	3.1 (0.9)	3.8 (0.8)	3.2 (0.6)	3.8 (0.7)	-	-	-
NC	5.3 (0.8)	5.9 (0.8)	5.4 (0.9)	-	6.2 (0.8)	4.9 (0.7)	-	-

OH	6.5 (0.9)	-	5.8 (0.9)	5.1 (0.8)	4.7 (0.8)	6.5 (0.9)	8.0 (1.1)	-
OK	4.4 (0.8)	5.1 (0.9)	5.0 (0.8)	6.1 (0.9)	6.9 (1.1)	6.0 (1.0)	6.5 (1.0)	0.04
OR	5.0 (1.0)	5.2 (0.9)	3.8 (0.8)	6.7 (1.0)	5.1 (0.9)	5.1 (0.9)	4.8 (0.8)	0.96
PA	-	-	-	-	6.3 (1.4)	3.8 (0.7)	6.4 (0.9)	-
RI	4.3 (0.7)	3.9 (0.6)	3.9 (0.6)	5.2 (0.8)	3.9 (0.7)	6.7 (0.9)	3.7 (0.7)	0.31
SC	7.4 (1.2)	4.7 (1.0)	5.9 (1.0)	5.3 (1.4)	6.2 (1.2)	-	-	-
TN	-	-	-	-	-	7.7 (1.5)	7.4 (1.4)	-
TX	-	-	-	-	-	-	7.0 (0.9)	-
UT	2.9 (0.6)	3.1 (0.4)	4.0 (0.5)	2.8 (0.4)	3.0 (0.5)	4.1 (0.6)	5.3 (0.7)	0.01
VT	4.2 (0.6)	5.4 (0.7)	6.0 (0.8)	4.0 (0.6)	5.5 (0.7)	5.3 (0.7)	6.1 (0.8)	0.19
WA	4.9 (0.9)	5.3 (0.9)	3.9 (0.7)	3.9 (0.8)	5.3 (0.9)	3.6 (0.7)	6.4 (1.0)	0.54
WV	6.1 (0.9)	6.5 (1.4)	7.0 (1.0)	6.4 (1.0)	7.9 (1.1)	7.6 (0.9)	7.0 (0.9)	0.26
WI	-	-	-	-	5.3 (0.9)	6.1 (1.0)	5.0 (0.9)	-
WY	-	-	-	-	3.5 (0.7)	5.5 (0.9)	5.1 (1.1)	-

[a]Includes only states with data for all time points (18 states)

[b]Includes only states with data for all time points (18 states), standardized by age and race-ethnicity

Appendix Table 3 (continued).

	Class III Obesity							
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**p-trend**
Overall[a]	2.9 (0.2)	3.0 (0.2)	3.5 (0.2)	3.2 (0.2)	3.5 (0.2)	3.6 (0.2)	3.7 (0.2)	<0.001
Overall[b]	2.6 (0.2)	2.7 (0.2)	3.1 (0.2)	2.9 (0.2)	3.2 (0.2)	3.2 (0.2)	3.4 (0.2)	<0.001
State								
AL	3.2 (0.6)	-	-	-	-	-	-	-
AK	3.8 (0.6)	3.2 (0.6)	4.5 (0.8)	3.7 (0.7)	3.9 (0.7)	2.9 (0.6)	3.8 (0.7)	0.75
AR	4.6 (0.7)	4.8 (0.7)	5.7 (0.7)	5.3 (0.7)	6.0 (0.9)	4.5 (0.7)	4.1 (0.8)	0.60
CO	2.0 (0.4)	1.6 (0.5)	2.0 (0.5)	3.8 (0.8)	2.0 (0.5)	1.6 (0.3)	2.7 (0.6)	0.46
DE	-	-	-	-	4.6 (0.9)	4.7 (0.7)	5.8 (0.8)	-
FL	2.4 (0.5)	2.2 (0.4)	3.7 (0.6)	-	-	-	-	-
GA	-	4.2 (0.7)	3.6 (0.6)	4.5 (0.7)	2.2 (0.9)	6.0 (1.3)	3.1 (0.9)	-
HI	2.2 (0.4)	2.5 (0.4)	2.2 (0.4)	1.8 (0.4)	2.7 (0.4)	3.1 (0.5)	2.2 (0.5)	0.47
IL	3.3 (0.6)	2.6 (0.4)	4.9 (0.7)	2.7 (0.5)	4.2 (0.6)	4.4 (0.6)	3.6 (0.6)	0.21
LA	3.9 (0.6)	5.1 (0.7)	-	-	-	-	-	-
ME	3.4 (0.6)	3.2 (0.6)	3.5 (0.6)	3.2 (0.6)	3.8 (0.7)	4.3 (0.7)	5.8 (0.9)	0.01
MD	4.3 (0.9)	3.5 (0.8)	2.9 (0.8)	2.6 (0.6)	4.0 (0.8)	3.2 (0.7)	4.0 (0.8)	0.85
MA	-	-	-	-	2.7 (0.7)	2.0 (0.4)	1.7 (0.5)	
MI	3.3 (0.6)	4.7 (0.7)	4.5 (0.7)	4.5 (0.8)	4.8 (0.7)	5.3 (0.7)	5.1 (0.7)	0.05

MN	3.0 (0.5)	2.4 (0.5)	1.8 (0.4)	2.3 (0.4)	2.4 (0.4)	3.4 (0.6)	2.6 (0.5)	0.59
MS	3.4 (0.6)	7.2 (1.0)	-	7.2 (1.1)	-	6.7 (0.9)	7.0 (0.9)	-
MO	-	-	-	-	4.2 (0.7)	-	5.4 (0.8)	-
NE	1.9 (0.4)	2.5 (0.5)	3.4 (0.5)	2.6 (0.5)	3.1 (0.6)	3.5 (0.6)	3.6 (0.6)	0.01
NJ	1.8 (0.3)	1.8 (0.4)	2.9 (0.5)	2.0 (0.4)	2.6 (0.5)	2.7 (0.5)	3.0 (0.5)	0.03
NM	2.5 (0.5)	2.5 (0.4)	2.5 (0.6)	-		-	-	-
NY	2.3 (0.6)	2.1 (0.6)	3.7 (0.7)	3.2 (1.0)	4.3 (0.9)	3.0 (0.7)	-	-
NYC	-	3.5 (1.0)	2.8 (0.7)	2.0 (0.5)	2.5 (0.6)	-	-	-
NC	5.2 (0.8)	3.4 (0.6)	3.9 (0.8)	-	3.9 (0.7)	4.4 (0.7)	-	-
OH	4.6 (0.8)	-	4.3 (0.8)	3.9 (0.7)	4.6 (0.8)	5.3 (0.8)	5.5 (0.9)	-
OK	2.8 (0.6)	3.3 (0.7)	4.0 (0.7)	5.3 (0.9)	4.1 (0.8)	5.6 (0.9)	4.5 (0.8)	0.02
OR	2.4 (0.7)	4.2 (0.9)	2.5 (0.6)	4.4 (0.9)	3.2 (0.7)	2.9. (0.7)	4.1 (0.8)	0.39
PA	-	-	-	-	3.8 (1.0)	3.3 (0.6)	3.8 (0.7)	-
RI	2.5 (0.5)	2.7 (0.6)	4.1 (0.7)	3.0 (0.6)	2.3 (0.5)	2.2 (0.5)	3.5 (0.7)	0.93
SC	4.3 (0.9)	3.4 (0.8)	3.7 (0.8)	4.1 (1.2)	7.8 (1.3)	-	-	-
TN	-	-	-	-	-	4.2 (1.0)	5.5 (1.2)	-
TX	-	-	-	-	-	-	4.0 (0.7)	-
UT	1.7 (0.4)	1.7 (0.4)	2.1 (0.4)	2.0 (0.4)	2.3 (0.4)	1.8 (0.4)	2.4 (0.5)	0.35
VT	3.1 (0.5)	3.6 (0.6)	3.7 (0.6)	3.1 (0.6)	4.5 (0.7)	3.6 (0.6)	4.0 (0.7)	0.27
WA	2.3 (0.5)	2.8 (0.6)	3.8 (0.8)	3.2 (0.7)	3.1 (0.7)	2.7 (0.6)	3.5 (0.7)	0.45
WV	4.4 (0.8)	5.2 (1.3)	3.9 (0.8)	5.8 (0.9)	5.4 (0.9)	6.4 (0.8)	6.9 (0.9)	0.01
WI	-	-	-	-	4.9 (0.9)	4.2 (0.8)	4.3 (0.8)	-
WY	-	-	-	-	1.9 (0.5)	3.5 (0.7)	3.7 (0.7)	-

[a]Includes only states with data for all time points (18 states)

[b]Includes only states with data for all time points (18 states), standardized by age and race-ethnicity

Appendix Table 4. Prepregnancy obesity prevalence among women <20 years by obesity severity and by state, 2003- 2009. Values are weighted percent (standard error).

	Moderately Obese								Severely Obese							
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**p-trend**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**p-trend**
Overall[a]	4.0 (0.7)	4.4 (0.7)	4.9 (0.8)	4.9 (0.7)	4.3 (0.6)	3.5 (0.6)	5.0 (0.8)	0.92	3.9 (0.6)	4.9 (0.8)	5.7 (0.9)	5.8 (0.8)	5.3 (0.7)	5.6 (0.7)	5.6 (0.7)	0.09
Overall[b]	4.1 (0.7)	4.2 (0.7)	4.8 (0.8)	5.0 (0.8)	4.3 (0.6)	3.4 (0.5)	5.0 (0.8)	0.85	3.8 (0.6)	5.0 (0.8)	5.9 (0.9)	5.7 (0.8)	5.2 (0.7)	5.6 (0.7)	5.7 (0.8)	0.09
State																
AL	2.3 (1.1)	-	-	-	-	-	-	-	8.1 (2.4)	-	-	-	-	-	-	-
AK	5.5 (2.3)	6.2 (3.1)	8.0 (3.4)	1.1 (0.6)	5.6 (2.6)	1.5 (0.8)	4.3 (2.6)	0.25	2.6 (0.8)	6.4 (2.5)	5.4 (2.8)	5.2 (2.2)	0.8 (0.2)	5.8 (2.8)	5.5 (2.5)	0.77
AR	1.8 (0.9)	7.0 (2.3)	9.0 (2.6)	4.9 (1.8)	3.9 (1.6)	3.8 (1.9)	1.8 (1.0)	0.18	6.2 (2.0)	4.1 (1.7)	9.0 (2.5)	7.4 (2.1)	4.9 (1.7)	6.2 (2.4)	7.5 (3.1)	0.73
CO	3.0 (1.9)	0.4 (0.4)	0.4 (0.3)	5.7 (3.2)	4.4 (3.0)	2.0 (1.1)	1.7 (0.7)	0.71	1.3 (0.9)	3.2 (1.7)	0.8 (0.5)	5.9 (2.8)	3.7 (1.8)	4.1 (2.3)	3.2 (1.4)	0.18
DE	-	-	-	-	9.2 (3.9)	4.8 (2.3)	4.4 (2.3)	-	-	-	-	-	11.9 (5.0)	8.5 (2.7)	9.7 (3.3)	-
FL	3.6 (1.5)	5.1 (1.7)	3.8 (1.5)	-	-	-	-	-	5.2 (1.7)	4.7 (1.7)	3.3 (1.3)	-	-	-	-	-
GA	-	2.2 (1.1)	4.7 (2.1)	7.2 (2.8)	4.2 (3.4)	7.9 (3.7)	8.1 (3.8)	-	-	4.1 (2.4)	4.0 (1.5)	3.8 (1.6)	6.4 (4.4)	2.4 (2.2)	8.5 (3.8)	-
HI	4.4 (1.7)	1.3 (1.2)	2.7 (1.5)	0 (0)	2.3 (1.5)	6.2 (2.3)	3.8 (1.9)	0.49	4.1 (1.8)	3.8 (1.7)	1.2 (1.1)	0 (0)	2.3 (1.5)	7.1 (2.5)	4.4 (2.4)	0.43
IL	5.0 (2.0)	0.7 (0.4)	5.0 (1.9)	3.9 (1.8)	4.1 (1.9)	4.9 (2.0)	4.7 (2.0)	0.56	3.0 (1.7)	4.4 (1.8)	3.6 (1.6)	8.5 (2.7)	3.7 (1.6)	6.1 (2.1)	5.6 (2.1)	0.26
LA	2.3 (1.1)	3.7 (1.5)	-	-	-	-	-	-	2.2 (1.2)	4.1 (1.7)	-	-	-	-	-	-
ME	6.2 (3.3)	2.8 (2.3)	9.4 (4.8)	6.7 (4.4)	2.4 (2.3)	2.6 (2.1)	6.0 (3.3)	0.60	9.7 (4.0)	0 (0)	4.8 (3.2)	4.9 (2.9)	5.0 (3.2)	4.0 (2.5)	2.8 (2.1)	0.40
MD	2.9 (1.8)	3.0 (2.6)	10.4 (5.4)	9.0 (3.9)	0.7 (0.4)	0.4 (0.3)	7.5 (4.9)	0.83	2.8 (2.2)	7.8 (4.3)	8.1 (4.8)	4.8 (3.2)	0.6 (0.3)	0.4 (0.3)	7.5 (4.9)	0.51
MA	-	-	-	-	4.3 (1.6)	7.9 (4.3)	6.5 (4.3)	-	-	-	-	-	5.3 (3.4)	6.9 (4.3)	16.5 (6.8)	-
MI	5.9 (2.6)	6.7 (3.2)	7.2 (3.1)	6.8 (2.5)	6.2 (2.0)	2.9 (1.2)	6.5 (2.5)	0.59	5.1 (2.1)	8.0 (3.0)	8.4 (3.5)	7.0 (3.0)	9.4 (2.7)	10.1 (2.7)	1.7 (0.7)	0.68
MN	0.7 (0.4)	8.2 (3.7)	1.3 (0.5)	3.8 (2.1)	7.1 (3.2)	1.8 (0.7)	2.2 (1.2)	0.63	1.7 (0.7)	1.0 (0.4)	7.2 (4.2)	1.1 (1.1)	6.3 (2.7)	2.3 (2.0)	1.4 (0.8)	0.81
MS	7.0 (2.2)	3.9 (1.7)	-	5.8 (2.5)	-	2.4 (1.1)	4.4 (1.8)	-	6.7 (2.3)	5.9 (1.9)	-	5.2 (2.5)	-	6.2 (2.1)	4.6 (1.7)	-

MO	-	-	-	-	2.0 (1.0)	-	6.2 (2.9)	-	-	-	-	-	4.1 (2.0)	-	2.9 (1.2)	-
NE	1.9 (0.7)	1.8 (1.2)	2.7 (1.1)	1.2 (0.7)	1.6 (0.7)	2.9 (2.1)	4.0 (1.9)	0.34	5.0 (2.3)	1.5 (0.6)	4.6 (2.3)	2.4 (1.1)	8.9 (3.1)	4.2 (2.3)	5.3 (2.4)	0.42
NJ	5.2 (2.4)	3.7 (1.9)	4.5 (2.2)	2.0 (1.3)	5.2 (2.7)	6.6 (3.2)	8.5 (3.9)	0.31	1.6 (1.1)	3.1 (1.7)	4.6 (1.9)	4.7 (2.5)	4.8 (2.6)	5.7 (3.2)	8.7 (3.8)	0.07
NM	1.4 (0.7)	3.1 (1.2)	1.1 (0.8)	-	-	-	-	-	4.2 (1.4)	3.2 (1.2)	4.9 (1.7)	-	-	-	-	-
NY	2.8 (2.8)	2.6 (2.2)	6.7 (4.3)	0.5 (0.5)	0 (0)	0 (0)	-	-	5.6 (3.8)	3.1 (2.6)	3.8 (3.1)	10.4 (7.0)	6.9 (4.6)	6.8 (4.6)	-	-
NYC	-	5.1 (5.0)	3.3 (3.0)	4.2 (2.6)	5.3 (3.6)	-	-	-	-	5.6 (5.0)	3.7 (3.0)	7.0 (3.7)	6.5 (3.5)	-	-	-
NC	3.5 (2.1)	9.8 (3.5)	7.1 (3.5)	-	8.8 (2.9)	5.5 (2.4)	-	-	6.2 (2.7)	4.9 (2.6)	7.9 (3.8)	-	2.7 (1.6)	8.8 (2.8)	-	-
OH	8.3 (3.5)	-	4.6 (2.0)	6.7 (2.8)	7.2 (2.8)	1.4 (1.3)	2.1 (1.0)	-	2.8 (2.1)	-	8.6 (4.1)	2.9 (0.9)	2.7 (1.7)	3.7 (1.9)	9.4 (3.8)	-
OK	2.1 (1.3)	7.2 (2.8)	1.0 (0.4)	8.2 (3.6)	1.1 (0.3)	4.7 (2.4)	2.5 (1.6)	0.71	2.7 (1.5)	9.8 (3.5)	11.9 (4.1)	3.9 (2.2)	6.4 (2.9)	5.1 (2.4)	11.6 (3.6)	0.38
OR	8.1 (4.4)	6.2 (3.6)	1.5 (0.7)	3.2 (1.0)	4.5 (3.3)	3.4 (1.5)	7.0 (4.0)	0.75	5.1 (2.6)	2.1 (1.0)	0.9 (0.6)	9.2 (4.0)	5.9 (3.3)	3.1 (1.2)	4.7 (3.0)	0.66
PA	-	-	-	-	5.8 (3.6)	7.5 (3.3)	4.5 (2.7)	-	-	-	-	-	5.1 (3.6)	2.3 (2.0)	1.9 (1.9)	-
RI	3.0 (1.7)	0.1 (0.1)	3.5 (2.0)	2.0 (1.6)	5.2 (2.3)	0.3 (0.1)	5.9 (2.9)	0.30	6.4 (2.6)	7.5 (2.7)	5.2 (2.6)	3.7 (2.2)	10.4 (3.5)	7.3 (2.9)	7.4 (3.1)	0.62
SC	6.3 (3.0)	0.6 (0.2)	12.8 (4.3)	2.3 (2.3)	6.9 (3.2)	-	-	-	7.2 (3.4)	6.4 (3.3)	2.3 (1.7)	13.2 (5.8)	11.2 (4.2)	-	-	-
TN	-	-	-	-	-	4.7 (3.1)	7.0 (3.2)	-	-	-	-	-	-	2.9 (2.6)	6.2 (3.3)	-
TX	-	-	-	-	-	-	6.5 (2.4)	-	-	-	-	-	-	-	5.1 (1.8)	-
UT	3.0 (2.7)	2.9 (1.2)	2.9 (1.5)	2.4 (1.0)	5.7 (1.9)	4.2 (2.0)	5.5 (2.6)	0.29	0.1 (0.1)	1.2 (0.6)	2.5 (1.1)	2.4 (1.4)	7.5 (2.4)	5.6 (2.6)	4.5 (1.9)	0.002
VT	3.4 (2.6)	4.3 (2.8)	8.0 (3.6)	5.6 (2.8)	6.2 (3.2)	3.8 (2.4)	2.5 (2.3)	0.61	1.0 (0.4)	2.1 (1.7)	4.4 (2.6)	5.6 (2.8)	7.6 (3.3)	7.9 (3.4)	10.9 (4.4)	0.01
WA	3.8 (1.9)	7.7 (4.1)	6.8 (3.4)	6.4 (3.2)	6.2 (2.9)	1.6 (1.1)	8.0 (3.7)	0.99	10.0 (4.4)	3.9 (3.2)	7.5 (4.0)	6.1 (3.1)	2.6 (1.2)	6.2 (2.8)	7.2 (3.3)	0.65
WV	3.1 (0.7)	2.0 (0.9)	3.3 (0.8)	4.3 (0.8)	4.1 (0.8)	4.3 (1.7)	3.0 (1.3)	0.64	3.7 (0.8)	7.6 (1.6)	5.7 (1.0)	5.1 (0.9)	6.4 (1.0)	5.1 (2.0)	6.5 (2.0)	0.42
WI	-	-	-	-	0 (0)	4.3 (1.9)	4.4 (2.8)	-	-	-	-	-	4.8 (1.8)	5.2 (2.1)	5.1 (3.0)	-
WY	-	-	-	-	6.2 (2.9)	1.7 (1.1)	5.2 (2.6)	-	-	-	-	-	2.9 (1.6)	0.8 (0.5)	1.8 (1.1)	-

[a]Includes only states with data for all time points (18 states)
[b]Includes only states with data for all time points (18 states), standardized by age and race-ethnicity