ORIGINAL RESEARCH

Racial/Ethnic Disparities in Screening for and Awareness of High Cholesterol Among Pregnant Women Receiving Prenatal Care

Reed Mszar, MPH; Dipika J. Gopal, MD; Rupa Chowdary; Cara Lea Smith, MD; Cara D. Dolin, MD, MPH; Melinda L. Irwin, PhD, MPH; Daniel Soffer, MD; Richard Nemiroff, MD; Jennifer Lewey, MD, MPH

BACKGROUND: Atherosclerotic cardiovascular disease remains a leading cause of morbidity and mortality among women, with younger women being disproportionately affected by traditional cardiovascular risk factors such as dyslipidemia. Despite recommendations for lipid screening in early adulthood and the risks associated with maternal dyslipidemia during pregnancy, many younger women lack access to and utilization of early screening. Accordingly, our objective was to assess the prevalence of and disparities in lipid screening and awareness of high cholesterol as an atherosclerotic cardiovascular disease risk factor among pregnant women receiving prenatal care.

METHODS AND RESULTS: We invited 234 pregnant women receiving prenatal care at 1 of 3 clinics affiliated with the University of Pennsylvania Health System to complete our survey. A total of 200 pregnant women (86% response rate) completed the survey. Overall, 59% of pregnant women (mean age 32.2 [±5.7] years) self-reported a previous lipid screening and 79% of women were aware of high cholesterol as an atherosclerotic cardiovascular disease risk factor. Stratified by racial/ethnic subgroups, non-Hispanic Black women were less likely to report a prior screening (43% versus 67%, \(P=0.022\)) and had lower levels of awareness (66% versus 92%, \(P<0.001\)) compared with non-Hispanic White women. Non-Hispanic Black women were more likely to see an obstetrician/gynecologist for their usual source of non-pregnancy care compared with non-Hispanic White women (18% versus 5%, \(P=0.043\)). Those seeing an obstetrician/gynecologist for usual care were less likely to report a prior lipid screening compared with those seeing a primary care physician (29% versus 63%, \(P=0.007\)).

CONCLUSIONS: Significant racial/ethnic disparities persist in lipid screening and risk factor awareness among pregnant women. Prenatal care may represent an opportunity to enhance access to and uptake of screening among younger women and reduce variations in accessing preventive care services.

Key Words: atherosclerotic cardiovascular disease ■ disparities ■ lipid screening ■ pregnancy ■ prevention ■ risk factors

Atherosclerotic cardiovascular disease (ASCVD) is a leading cause of morbidity and mortality among women in the United States.\(^1\) Though recent data show an overall decline in ASCVD incidence and mortality, a stagnation in population-level trends has been observed among younger women (aged <55 years).\(^2-4\) The increased prevalence of traditional ASCVD risk factors such as diabetes mellitus, obesity and overweight, hypertension, and dyslipidemia may contribute, in part, to current trends.\(^5\) Compared with all other known ASCVD risk factors, dyslipidemia is a leading population-adjusted risk factor among women.\(^5\) Moreover, younger women with undiagnosed and undertreated lipid disorders, including familial hypercholesterolemia (FH), are known to be at greater risk for developing early ASCVD (aged <65 years).\(^6\) Despite recommendations for the screening of lipid disorders in early...
adulthood, less than half of women have had a prior lipid screening, with considerable disparities existing for non-White women and socioeconomically disadvantaged populations. Therefore, novel strategies are needed to increase access to and use of lipid screening for younger women to prevent early ASCVD and identify potential lipid disorders.

Considering that nearly 86% of women will have experienced at least 1 pregnancy by age 45 years, pregnancy, often referred to as a cardiometabolic “stress test,” represents a unique opportunity to not only screen for potential lipid disorders, but also to leverage obstetric/gynecologic history to assess ASCVD risk and enhance risk factor awareness in women. While general knowledge, awareness, and perceived susceptibility to disease have been shown to increase prevention-seeking behaviors, public understanding of risk factors for ASCVD has also been deemed essential for primary and secondary prevention.

Integrating these strategies for screening during pregnancy and throughout early prenatal care may help inform close follow-up and referral transitions to a primary care physician or cardiovascular specialist during the postpartum period.

Accordingly, the objective of this study was to survey pregnant women receiving prenatal care to assess the prevalence of prior lipid screenings and awareness of high cholesterol as an ASCVD risk factor. Our goal was to assess the presence of any prior lipid screening before survey administration. Additionally, we aimed to characterize disparities in screening and awareness based on race/ethnicity and other sociodemographic characteristics in our urban population of pregnant women.

**METHODS**

The authors declare that all supporting data are available within the article (and its online supplementary files).

**Study Design and Participants**

This cross-sectional survey study sought to assess and compare the prevalence of lipid screening and awareness of high cholesterol as an ASCVD risk factor among pregnant women receiving prenatal care from 1 of 3 clinics affiliated with the University of Pennsylvania Health System (UPHS) between May 31, 2019 and August 1, 2019. Surveys were administered in-person to pregnant, English-speaking women aged ≥18 years at the time of any prenatal care visit occurring during the study period. As a result, our study population resembled a “convenience sample” in which pregnant women were not selected by means of a simple or stratified random sampling
scheme, rather roughly the majority of women attending their prenatal care visit at UPHS were invited to participate in our study during the specified study duration. After obtaining informed consent forms and completed surveys, clinical measures and lipid screening characteristics were abstracted from participants’ electronic medical records (EMR). Racial/ethnic differences were assessed upon stratifying participants based on race (White, Black, Asian, or multiracial [defined as identifying with more than one racial group]) and ethnicity (Hispanic or non-Hispanic [NH]). Because of a limited sample size for Hispanic, Asian, and multiracial women, analyses were primarily conducted among NH White and NH Black women. Pregnant women were excluded if they were aged <18 years or if they were not proficient in English.

Survey Development and Administration
We developed a survey that assessed pregnant women’s demographic and clinical characteristics including race/ethnicity, highest level of completed education, annual household income, family history of high cholesterol and ASCVD, and current and/or former health conditions during pregnancy such as gestational diabetes mellitus, gestational hypertension, and preeclampsia. The presence of a previous premature birth was defined as delivery <37 weeks of gestation. Participants’ gestational age was categorized by trimester at the time of survey completion. We also assessed whether women had a usual source of non-pregnancy care and if so, with what type of healthcare provider (survey questions in Data S1).

Our main outcomes included a self-reported presence of any prior lipid screening and an awareness of high cholesterol as an ASCVD risk factor. The presence of any prior lipid screening was assessed based on participants’ response to the question, “Have you ever had your cholesterol levels checked with a blood test?”. Among women reporting a prior screening, we assessed the timing of screening (within the past year, 2 years, or 5 years or longer) and the type of provider who ordered the screening test (primary care physician, obstetrician/gynecologist [OB/GYN], or other). Additionally, participants’ relative awareness of high cholesterol as an ASCVD risk factor was evaluated based on the survey question, “Have you ever heard that high cholesterol is a risk factor for developing heart disease?”. Finally, we assessed participants’ acceptability of lipid screening during early pregnancy by posing the following statement: “I would like my OB/GYN to check my cholesterol levels during early pregnancy, at the same time that I am getting my blood drawn for other necessary tests” and classifying responses based on a 5-point Likert scale (strongly disagree to strongly agree) after providing a brief passage about the potential risks and benefits of early screening (Data S1). The survey was validated among a small group of pregnant and recently postpartum women receiving care at UPHS, and the survey was accordingly updated based on their feedback.

EMR Data Collection
Upon survey completion, we reviewed each respondent’s medical records to ascertain additional clinical characteristics and documentation of prior lipid screening results. Specifically, we abstracted prior levels of low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, total cholesterol, and triglycerides (in mg/dL). The timing of prior EMR-documented screening was determined by the elapsed time between test date and the date of survey completion. Six participants had missing EMR data and were excluded from EMR aspects of subsequent statistical analyses yielding an overall sample of 194 women with complete data. Analyses based on racial/ethnic differences in EMR-documented lipid levels were conducted to include all documented lipid profile results as well as a subsequent sensitivity analysis excluding results from 1 woman with suspected undiagnosed FH, based on the Dutch Lipid Clinic Network diagnostic criteria. 6,26,27

Statistical Analysis
We analyzed continuous and categorical descriptive data using 2-tailed t test and Chi-square analysis or Fisher exact test, respectively. We conducted logistic regression analysis to ascertain the association between participants’ characteristics and absence of prior lipid screening and lack of awareness of high cholesterol as an ASCVD risk factor. Self-reported screening and risk factor awareness responses were dichotomized into “yes” and “no/unsure” because of the relatively small sample size. Odds ratios (OR) and 95% CI were produced for unadjusted and adjusted associations. Our final model for logistic regression analyses adjusted for age, race/ethnicity, education level, and usual source of care status was developed based on a backward elimination strategy, in which variables were removed individually from an originally full model if not statistically significant to produce the most parsimonious final model. 28 A P<0.05 was considered statistically significant. Analyses were conducted with SAS, version 9.4 (SAS Inc., Cary, NC). The protocol and survey instrument were approved by the Institutional Review Board at the University of Pennsylvania.

RESULTS
We invited 234 pregnant women receiving prenatal care at UPHS to take our survey, in which 200 surveys were
completed (85.5% response rate). Overall, 68% of participants were aged <35 years (mean [±SD] age, 32.2 [±5.7] years) and approximately half (51%) were >28 weeks of gestation at the time of survey completion (Table 1). We observed the following racial/ethnic distribution in our sample: 46% NH White, 34% NH Black, 9% Asian, 6%

| Study Variables | Overall Population (n=200)* | NH White (n=91) | NH Black (n=68) | P Value |
|-----------------|-----------------------------|----------------|----------------|---------|
| Age, mean (SD)  | 32.2 (5.7)                  | 34.1 (5.0)     | 29.6 (5.8)     | <0.001  |
| Age categories, y |                             |                |                |         |
| 18–34           | 133 (67.9)                  | 53 (56.9)      | 66 (82.4)      |         |
| ≥35             | 63 (32.1)                   | 37 (41.1)      | 12 (17.7)      |         |
| Race/Ethnicity  |                             |                |                |         |
| NH White        | 91 (45.5)                   | 91 (100.0)     | 0 (0.0)        |         |
| NH Black        | 68 (34.0)                   | 0 (0.0)        | 68 (100.0)     |         |
| Asian           | 18 (9.0)                    | 0 (0.0)        | 0 (0.0)        |         |
| Hispanic        | 12 (6.0)                    | 0 (0.0)        | 0 (0.0)        |         |
| Multiracial     | 9 (4.5)                     | 0 (0.0)        | 0 (0.0)        |         |
| Missing         | 2 (1.0)                     | 0 (0.0)        | 0 (0.0)        |         |
| Gestational age (wk) at time of survey | | | | 0.214 |
| 1–13            | 18 (9.3)                    | 10 (11.2)      | 6 (9.0)        |         |
| 14–27           | 78 (40.2)                   | 42 (47.2)      | 22 (32.8)      |         |
| 28+             | 98 (50.5)                   | 37 (41.6)      | 39 (58.2)      |         |
| Education       |                             |                |                | <0.001  |
| High school/GED or lower | 40 (20.2) | 6 (6.6) | 28 (41.2) |         |
| Some college or associate degree | 42 (21.2) | 10 (11.0) | 22 (32.4) |         |
| College graduate or above | 116 (58.6) | 75 (82.4) | 18 (26.5) |         |
| Annual household income |                             |                |                | <0.001  |
| <$20 000        | 19 (11.7)                   | 3 (3.7)        | 11 (21.6)      |         |
| $20 000–$49 999 | 32 (19.8)                   | 3 (3.7)        | 23 (45.1)      |         |
| $50 000–$99 999 | 35 (21.6)                   | 15 (18.5)      | 12 (23.5)      |         |
| ≥$100 000       | 76 (46.9)                   | 60 (74.1)      | 5 (9.8)        |         |
| Usual source of non-pregnancy care | | | | 0.330 |
| Yes             | 172 (87.8)                  | 77 (85.6)      | 63 (92.7)      |         |
| No              | 24 (12.2)                   | 13 (14.4)      | 5 (7.4)        |         |
| Non-pregnancy care provider type | | | | 0.043 |
| Primary care, family medicine | 153 (90.0) | 71 (94.7) | 52 (82.5) |         |
| OB/GYN          | 17 (10.0)                   | 4 (5.3)        | 11 (17.5)      |         |
| Family history of high cholesterol | | | | 0.002 |
| Yes             | 67 (34.5)                   | 43 (47.8)      | 11 (16.4)      |         |
| No              | 95 (49.0)                   | 36 (40.0)      | 40 (59.7)      |         |
| Unsure          | 32 (16.5)                   | 11 (12.2)      | 16 (23.9)      |         |
| Family history of cardiovascular disease | | | | 0.548 |
| Yes             | 32 (16.2)                   | 13 (14.3)      | 11 (16.4)      |         |
| No              | 156 (83.8)                  | 78 (85.7)      | 56 (83.6)      |         |
| Past OB history |                             |                |                |         |
| Gestational diabetes mellitus | 17 (8.6) | 6 (6.6) | 6 (8.8) | 0.562 |
| Gestational hypertension | 13 (6.6) | 7 (7.7) | 6 (8.8) | 0.160 |
| Preecclampsia   | 18 (9.1)                    | 6 (6.6)        | 10 (14.7)      | 0.123  |
| Prematurity birth (<37 wks of gestation) | 17 (8.6) | 5 (5.5) | 10 (14.7) | 0.078 |

NH indicates non-Hispanic; OB, obstetric; and OB/GYN, obstetrician/gynecologist. 
*P value represents statistical comparison between NH White and NH Black subgroups.
Hispanic, and 5% multiracial (Table 1). In our sample, 59% of women had completed college or higher and 47% of participants indicated an annual household income of ≥$100,000. We found that 88% of women had a usual source of non-pregnancy care, with 90% receiving care from a primary care physician or family medicine practitioner and only 10% from an OB/GYN. Additionally, 35% and 16% of women reported having a family history of high cholesterol and ASCVD, respectively.

We found significant differences in demographic and clinical characteristics between NH Black and NH White women (Table 1). Notably, a smaller proportion of NH Black women were aged ≥35 years compared with NH White women (18% versus 41%, \( P = 0.004 \)). Additionally, NH Black women were less likely to have completed college or higher compared with NH White women (27% versus 82%, \( P < 0.001 \)) and less likely to report an annual household income ≥$100,000 compared with NH White women (10% versus 74%, \( P < 0.001 \)). Our results also showed that NH Black women were more likely to indicate that an OB/GYN was their usual source of non-pregnancy care compared with NH White women (18% versus 5%, \( P = 0.043 \)).

Asian, Hispanic, and multiracial women were not included in our primary statistical analyses because of smaller sample sizes (Table S1). Among our participants, 78% of Asian, 33% of Hispanic, and 56% of multiracial women had completed college or higher. Among these racial/ethnic subgroups, 47%, 30%, and 20% reported an annual household income of ≥$100,000, respectively.

Overall, 118 (59%) pregnant women reported a previous lipid screening, with the majority of participants (57%) indicating that they received this screening within the past year (Table 2). Among women reporting prior screening, 63% and 19% of women received screening from a primary care physician and OB/GYN, respectively. We found that 79% of participants were aware of high cholesterol as an ASCVD risk factor and 71% found lipid screening during early pregnancy care acceptable. Among women with a prior lipid screening, 91% reported normal levels while 4% and 3% reported borderline and abnormal levels, respectively.

When stratified by race/ethnicity, we observed that NH Black women were less likely to self-report a prior lipid screening (43% versus 67%, \( P = 0.022 \)) and were less likely to be aware of high cholesterol as an ASCVD risk factor (66% versus 92%, \( P < 0.001 \)) compared with NH White women. Acceptability of lipid screening

| Table 2. Self-Reported Lipid Screening Characteristics and Risk Factor Awareness Stratified by Non-Hispanic White and Non-Hispanic Black Racial/Ethnic Subgroups |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Screening Characteristics        | Overall (n=200) | NH White (n=91) | NH Black (n=68) | \( P \) Value*   |
| Prior lipid screening            |                 |                 |                 | 0.022           |
| Yes                             | 118 (59.0)      | 61 (67.0)       | 29 (42.7)       |                 |
| No                              | 30 (15.0)       | 11 (12.1)       | 14 (20.6)       |                 |
| Unsure                          | 52 (26.0)       | 19 (20.9)       | 25 (36.8)       |                 |
| Timing of prior lipid screening  |                 |                 |                 | 0.077           |
| Within past y                   | 68 (57.1)       | 29 (48.3)       | 22 (73.3)       |                 |
| Within past 2 y                 | 23 (19.3)       | 11 (18.3)       | 6 (20.0)        |                 |
| Within past 5 y or longer       | 28 (23.5)       | 20 (33.3)       | 2 (6.7)         |                 |
| Type of provider ordering screening |                 |                 |                 | 0.355           |
| Primary care or family medicine | 79 (63.2)       | 38 (61.3)       | 25 (75.8)       |                 |
| OB/GYN                          | 24 (19.2)       | 11 (17.7)       | 5 (15.2)        |                 |
| Other                           | 22 (17.6)       | 13 (21.0)       | 3 (9.1)         |                 |
| Awareness of high cholesterol as risk factor |                 |                 |                 | <0.001          |
| Yes                             | 158 (79.0)      | 84 (92.3)       | 45 (66.2)       |                 |
| No                              | 35 (17.5)       | 7 (7.7)         | 16 (23.5)       |                 |
| Unsure                          | 7 (3.5)         | 0 (0.0)         | 7 (10.3)        |                 |
| Acceptability of screening during pregnancy |                 |                 |                 | 0.610           |
| Agree                           | 141 (71.2)      | 63 (69.2)       | 46 (68.7)       |                 |
| Neutral                         | 44 (22.2)       | 22 (24.2)       | 15 (22.4)       |                 |
| Disagree                        | 13 (6.6)        | 6 (6.6)         | 6 (9.0)         |                 |

NH indicates non-Hispanic; and OB/GYN, obstetrician/gynecologist.

*\( P \) value represents statistical comparison between NH White and NH Black subgroups.
during pregnancy was similar between NH White and NH Black women. Additionally, the prevalence of lipid screening among Asian, Hispanic, and multiracial women was 67%, 83%, and 44%, respectively, while an awareness of high cholesterol as an ASCVD risk was present in 72%, 75%, and 56% of women in each respective subgroup.

Figure and Table S2 show baseline characteristics associated with a self-reported history of lipid screening, including age ≥35 years compared with <35 years (53% versus 72%, P = 0.011) and NH Black compared with NH White race/ethnicity (43% versus 67%, P = 0.007). Highest completed level of education was associated with a stepwise increase in screening rates (P = 0.002). Baseline characteristics associated with risk factor awareness included age ≥35 compared with <35 years (68% versus 75%, P = 0.041), NH Black compared with NH White race/ethnicity (66% versus 92%, P < 0.001) and having a usual source of non-pregnancy care compared with not having usual care (82% versus 63%, P = 0.030). Highest completed level of education (P = 0.006) and household income (P = 0.003) were associated with a stepwise increase in awareness rates. Family history of high cholesterol or cardiovascular disease were not associated with the presence of prior lipid screening.

The results of the unadjusted and adjusted analyses are presented in Tables 3 and 4. Based on our unadjusted analysis of factors associated with greater odds of lacking prior lipid screening, we found significant associations based on younger age (OR, 2.28; 95% CI, 1.20–4.33; P = 0.012), NH Black race/ethnicity (OR, 2.73; 95% CI, 1.43–5.24; P = 0.002), lower education level (OR, 3.76; 95% CI, 1.77–8.00; P = 0.001), and lower household income (OR, 2.23; 95% CI, 1.16–4.30; P = 0.017). After adjusting for age, race/ethnicity, education, and usual source of non-pregnancy care, we found that NH Black race/ethnicity remained statistically significant (OR, 3.35; 1.29–8.67; P = 0.013). Similarly, we found significant unadjusted associations between lack of risk factor awareness and younger age (OR, 2.35; 95% CI, 1.02–5.44; P = 0.046), NH Black race/ethnicity (OR, 6.13; 95% CI, 2.44–15.39; P < 0.001), lower education level (OR, 3.43; 95% CI, 1.49–7.92; P = 0.004), lower household income (OR, 4.19; 95% CI, 1.61–10.95; P = 0.003), and no usual source of care (OR, 2.66; 95% CI, 1.07–6.62; P = 0.035). After adjusting for these covariates, NH Black race/ethnicity (OR, 8.92; 95% CI, 2.07–38.42; P = 0.003) and no usual source of care (OR, 8.60; 95% CI, 1.73–42.69; P = 0.009) remained statistically significant.

Upon our abstraction of EMR data, only 62 (32%) women had evidence of a prior lipid screening (Table 5). NH White women had higher rates of lipid screening compared with NH Black women (39% versus 19%, P = 0.016). We identified 1 NH Black participant with suspected FH who had not yet been formally diagnosed. Excluding this participant for sensitivity analyses, the mean (SD) lipid levels included the following: total cholesterol of 174.4 (28.5) mg/dL, low-density lipoprotein cholesterol of 96.7...
Table 3. Unadjusted and Adjusted Associations Between Sociodemographic Characteristics and Lack of Prior Lipid Screening

| Study Variables          | Lack of Prior Lipid Screening |                  |                  |
|-------------------------|-----------------------------|------------------|------------------|
|                         | Unadjusted                  | P Value          | Adjusted*        | P Value          |
| Age, y                  |                             | 0.012            | 0.407            |
| 18–34                   | 2.28 (1.20–4.33)            | 1.44 (0.61–3.42) |                  |
| ≥35                     | Reference                   | Reference        |                  |
| Race/Ethnicity          |                             | 0.002            | 0.013            |
| NH Black                | 2.73 (1.43–5.24)            | 3.35 (1.29–8.67) |                  |
| NH White                | Reference                   | Reference        |                  |
| Education               |                             | 0.001            | 0.196            |
| ≤ Some college          | 3.76 (1.77–8.00)            | 1.96 (0.71–5.43) |                  |
| ≥ College graduate      | Reference                   | Reference        |                  |
| Household income        |                             |                  |                  |
| <$100 000/y             | 2.23 (1.16–4.30)            |                  |                  |
| ≥$100 000/y             | Reference                   | Reference        |                  |
| Usual source of care    |                             | 0.310            | 0.100            |
| No                      | 1.56 (0.66–3.67)            | 2.78 (0.82–9.37) |                  |
| Yes                     | Reference                   | Reference        |                  |

Values are presented as odds ratios (OR) and 95% CI. Unadjusted estimates derived from distinct logistic regression models for each study variable, adjusted estimates derived from single model with “...” representing variables not retained in the final model through backward elimination as they were not statistically significant in original full model. NH indicates non-Hispanic.

*Adjusted for age, race/ethnicity, education, and usual source of non-pregnancy care.

(25.8) mg/dL, high-density lipoprotein cholesterol of 60.9 (13.4) mg/dL, and triglycerides of 84.2 (40.8) mg/dL (Table S3). NH White women had significantly higher high-density lipoprotein cholesterol levels compared with NH Black women (63 versus 52 mg/dL, \( P=0.048 \)).

Table 4. Unadjusted and Adjusted Associations Between Sociodemographic Characteristics and a Lack of Awareness of High Cholesterol as a Cardiovascular Risk Factor

| Study Variables          | Lack of Risk Factor Awareness |                  |                  |
|-------------------------|-------------------------------|------------------|------------------|
|                         | Unadjusted                  | P Value          | Adjusted*        | P Value          |
| Age, y                  |                              | 0.046            | 0.517            |
| 18–34                   | 2.35 (1.02–5.44)             | 1.56 (0.41–6.00) |                  |
| ≥35                     | Reference                    | Reference        |                  |
| Race/Ethnicity          |                              | <0.001           | 0.003            |
| NH Black                | 6.13 (2.44–15.39)            | 8.92 (2.07–38.42) |                  |
| NH White                | Reference                    | Reference        |                  |
| Education               |                              | 0.004            | 0.406            |
| ≤ Some college          | 3.43 (1.49–7.92)             | 1.66 (0.50–5.50) |                  |
| ≥ College graduate      | Reference                    | Reference        |                  |
| Household income        |                              | 0.003            |                  |
| <$100 000/y             | 4.19 (1.61–10.95)            |                  |                  |
| ≥$100 000/y             | Reference                    | Reference        |                  |
| Usual source of care    |                              | 0.035            | 0.009            |
| No                      | 2.66 (1.07–6.62)             | 8.60 (1.73–42.69) |                  |
| Yes                     | Reference                    | Reference        |                  |

Values are presented as odds ratios (OR) and 95% CI. Unadjusted estimates derived from distinct logistic regression models for each study variable, adjusted estimates derived from single model with “...” representing variables not retained in the final model through backward elimination as they were not statistically significant in original full model. NH indicates non-Hispanic.

*Adjusted for age, race/ethnicity, education, and usual source of non-pregnancy care.
DISCUSSION

In our sample of pregnant women receiving prenatal care in a large, racially diverse urban area, we found that 59% of participants reported a prior lipid screening. Our findings demonstrated significant disparities in lipid screening by age, race/ethnicity, and education along with differences in risk factor awareness by these characteristics along with household income and usual source of care status. Notably, we found that NH Black women were significantly less likely to report a prior screening and had lower rates of risk factor awareness compared with NH White women. After adjusting for covariates, NH Black women had significantly higher odds of lacking a prior lipid screening. Moreover, NH Black women and those without a usual source of care also had greater adjusted odds of being unaware of high cholesterol as a cardiovascular risk factor.

Though prior studies have provided evidence for racial/ethnic and sociodemographic differences in lipid screening practices, our cross-sectional survey represents one of the first studies demonstrating disparities in lipid screening and risk factor awareness among pregnant women receiving prenatal care. Our overall prevalence of lipid screening corresponded to those previously observed outside of pregnancy. For instance, Kuklina and colleagues showed a lipid screening rate of ≈50%, with minimal variations depending on the number of ASCVD risk factors present. Lower socioeconomic status, lack of healthcare access, immigration status, and language barriers have also been shown to be significant predictors of racial and ethnic disparities in lipid screening. Notably, our results align with population-level data from the National Health and Nutrition Examination Survey (NHANES) that found that NH White individuals were more likely to be screened for high blood cholesterol levels compared with NH Black individuals (65% versus 58%).

In addition to observing differences in lipid screening rates by self-report and through assessment of participants’ medical records, significant racial/ethnic differences were identified in awareness of high cholesterol as a risk factor for ASCVD. Our work can be interpreted alongside other studies that have assessed awareness of high cholesterol as a key modifiable risk factor. In a nationally representative sample of women, Mosca et al found that an awareness of increased ASCVD burden over time was higher in White women than Black women (62% versus 38%) and was independent of correlated with increased physical activity and weight loss. The authors found that only 46% of women could recall their lipid levels and that White women were significantly more knowledgeable of healthy lipid levels than either Black or Hispanic women (P<0.05). Additionally, Huang and colleagues found that among nearly 40 000 women without ASCVD in the Women’s Health Study, women who were aware of their lipid levels had higher incomes and were more educated when compared with those who were unaware, findings similar to the stepwise associations presented.

For inherited conditions of lipid metabolism such as FH, novel approaches are urgently needed for identifying probands and initiating cascade screening in close family members when applicable. With ≈90% of those with FH remaining undiagnosed and significant racial/ethnic disparities observed based on low-density lipoprotein cholesterol achievement among those with FH, interdisciplinary strategies for integrating screening and cardiovascular risk assessment during a period of greater healthcare use may translate into a higher yield of case identification and subsequent cascade screening. Since preventive health visits to an OB/GYN provider are often focused on reproductive health-related services, women of reproductive age who use OB/GYN services primarily for preventive care may not be receiving...
a comprehensive spectrum of preventive screenings, counseling, and follow-up care. Our results show that women who identify their OB/GYN as their usual source of non-pregnancy care were significantly less likely to undergo lipid screening compared with those seeing a primary care or family medicine practitioner. Leveraging the perinatal period is currently an underutilized opportunity to screen for potential lipid disorders, promote primary prevention of ASCVD, and inform necessary follow-up care and counseling, if needed.

Engaging OB/GYN practitioners has been identified as a potential strategy for enhancing ASCVD prevention considering the high frequency in which women receive healthcare services from OB/GYNs during reproductive years, though barriers to effective screening, management, and referrals have been reported. One national survey of OB/GYNs found that, while 61% of practitioners provided more than reproductive care when providing well-woman care, they were unlikely to manage elevated lipid levels. Moreover, in a focus group of OB/GYNs, knowledge gaps and skill deficits along with liability concerns and barriers to prevention were identified as practice barriers. Increased awareness initiatives, educational interventions, and multidisciplinary partnerships are needed to effectively communicate the reliability of lipid screening tests during early pregnancy, particularly during the first trimester before significant changes in lipid metabolism occur.

Racial differences in prior lipid screenings were also observed upon review of participants’ EMR data. Overall, fewer patients had EMR-documented lipid screening compared with self-report. This may be a result of patients undergoing lipid screenings at other testing sites or through workplace wellness programs as well as being attributable to participant recall bias. Among the 194 women without missing EMR data, we identified at least 1 probable FH case that had not been previously evaluated by a clinical lipidology or cardiovascular specialist. While plasma cholesterol and triglyceride levels have been shown to increase by 25% to 50% and 150% to 300%, respectively, during pregnancy, women with FH experience a higher absolute increase in lipid levels, thus potentially putting them at greater risk for accelerated atherosclerosis. Though statins and other lipid-lowering medications such as ezetimibe and PCSK9 (proprotein convertase subtilisin/kevin type 9) inhibitors are contraindicated and therefore not recommended during pregnancy and lactation, identifying FH earlier in life is critical for initiating appropriate postpartum follow-up care including lipid-lowering agents. Engaging OB/GYNs as key partners in ASCVD prevention, management, and counseling represents a unique opportunity to screen for potential lipid disorders, assess future cardiovascular risk, and leverage specialized postpartum follow-up care. Future studies will need to evaluate effective strategies for operationalizing lipid screening and follow-up for those with abnormal lipid results, especially among vulnerable populations.

Limitations
Our findings should be interpreted considering several limitations. First, responses to our survey may have been subject to response and/or recall bias. Despite aiming to survey all eligible women present in the waiting room during survey administration visits and an overall high response and completion rate, the risk of selection bias cannot be discounted. Second, the retrospective review of the EMR did not capture all relevant clinical characteristics, such as prior diagnosis of hypertension or diabetes mellitus and was subject to missing data. Third, our sample size limited our ability to further evaluate associations between lipid screening and risk factor awareness with sociodemographic characteristics in other subgroups. The relatively small sample size may have also reduced precision in the reported effect estimates. Fourth, our study used an investigator-developed survey instrument, thereby strengthening the case for implementing future validation studies in larger, nationally representative cohorts. Additionally, carrying out focus groups and/or cognitive interviews would help reduce bias and ensure a more equitable understanding of survey contents and questions, particularly given differences in educational attainment by race/ethnicity. Lastly, the external validity of our findings was limited to English-speaking, pregnant women receiving prenatal care in an urban setting and may not be generalizable to other populations.

CONCLUSIONS
Despite current guidelines recommending focused screening for lipid disorders in early adulthood along with the health risks associated with maternal dyslipidemia, we found that 2 in 5 pregnant women did not report a prior lipid screening and 1 in 5 were unaware of high cholesterol as an ASCVD risk factor. Significant racial/ethnic and sociodemographic disparities were associated with both lack of screening and risk factor awareness. Leveraging prenatal and early pregnancy care may represent an opportunity to enhance lipid screening among younger women, identify potential lipid disorders, and reduce current variations in accessing preventive cardiovascular services.

ARTICLE INFORMATION
Received May 5, 2020; accepted October 20, 2020.

Affiliations
From the Department of Chronic Disease Epidemiology, Yale School of Public Health, New Haven, CT (R.M., M.L.I.); Division of Cardiology (D.J.G., C.L.S., D.S., J.L.); Department of Medicine (R.C.) and Department of Obstetrics...
and Gynecology, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA (C.D.D., R.N.).

Sources of Funding
None.

Disclosures
Dr. Soffer has received grants to the institution from AstraZeneca, Novartis, Regeneron, Akcea Therapeutics, National Institutes of Health, and REGENxBio, served as consultant for Amgen Inc, Akcea Therapeutics, Regeneron, Medicare, and as a speaker for Sanofi and Akcea Therapeutics. The remaining authors have no disclosures to report.

Supplementary Material
Data S1
Tables S1–S3

REFERENCES
1. Grundy SM, Stone NJ, Bailey AL, Beem C, Bircsher KK, Blumenthal RS, Braun LT, de Ferrari S, Faella-Tommasino J, Forman DE, et al. 2018 AHA/ACC/AACVPR/ABA/ACPM/ADA/AGS/APhA/ASP/NLA/PCNA guideline on the management of blood cholesterol: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation. 2019;139:e1082–e1143.
2. Park K, Wu P, Gulati M. Obstetrics and gynecological history. JACC Case Rep. 2020;2:161–163.
3. Garcia M, Mulvagh SL, Merz CN, Buring JE, Manson JE. Cardiovascular disease in women: clinical perspectives. Circ Res. 2018;118:1273–1293.
4. Wilmot KA, O’Flaherty M, Capewell S, Ford ES, Vaccarino V. Coronary heart disease mortality declines in the United States from 1979 through 2011: evidence for stagnation in young adults, especially women. Circulation. 2015;132:997–1002.
5. Yusuf S, Hawn S, Öunpuu S, Dan T, Avezum A, Lanas F, McQueen M, Budaj A, Pais P, Varigos J, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet. 2004;364:393–395.
6. Nordestgaard BG, Chapman MJ, Humphries SE, Ginsburg HH, Masana L, Descamps OS, Wiklund O, Hegele RA, Raal FJ, Defesche JC, et al. Familial hypercholesterolaemia is underdiagnosed and undertreated in the general population: guidance for clinicians to prevent coronary heart disease: consensus statement of the European Atherosclerosis Society. Eur Heart J. 2013;34:3478–3490a.
7. Toth PP, Potter D, Ming EE. Prevalence of lipid abnormalities in the United States: the National Health and Nutrition Examination Survey 2003–2008. J Clin Lipidol. 2012;6:325–330.
8. Kuklina EV, Yoon PW, Keenan NL. Prevalence of coronary heart disease risk factors and screening for high cholesterol levels among young adults, United States, 1999–2006. Ann Fam Med. 2010;8:327–333.
9. Kenik J, Jean-Jacques M, Feinglass J. Explaining racial and ethnic disparities in cholesterol screening. Prev Med. 2014;65:65–69.
10. Grant D, Scott R, Harrison T, Cheetham T, Chang S, Hisu J, Wei R, Boklage S, Romo-LeTourneau V, Reynolds C. Trends in lipid screening among adults in an integrated health care delivery system, 2009–2015. J Manag Care Spec Pharm. 2018;24:1090–1101.
11. Stimpson JP, Wilson FA, Murillo R, Pagan JA. Persistent disparities in cholesterol screening among immigrants to the United States. Int J Equity Health. 2012;11:22.
12. Brown DW, Giles WH, Greenland J, Croft JB. Disparities in cholesterol screening: falling short of a national health objective. Prev Med. 2003;33:517–522.
13. Vrijkotte TG, Kruiziener N, Hutten BA, Vollebregt KC, van Eijden M, Twisk MJ. Maternal lipid profile during early pregnancy and pregnancy complications and outcomes: the ABCD study. J Clin Endocrinol Metab. 2012;97:2917–2925.
14. Martin J, Hamilton B, Osterman M, Driscoll A, Drake P. Births: final data for 2016. Natl Vital Stat Rep. 2018;67:1–54.
15. Stormo AR, Saraiya M, Hing E, Henderson JT, Sawaya GF. Women’s clinical preventive services in the United States. JAMA Intern Med. 2014;174:1512–1514.
16. Wang C, Kong L, Yang Y, Wei Y, Zhu W, Su R, Lin L, Yang H. Recommended reference values for serum lipids during early and middle pregnancy: a retrospective study from China. Lipids Health Dis. 2018;17:246.
17. Ryckman KK, Spracklen CN, Smith CJ, Robinson JG, Saftlas AF. Maternal lipid levels during pregnancy and gestational diabetes: a systematic review and meta-analysis. BJOG. 2015;122:643–651.
18. Herrera E. Lipid metabolism in pregnancy and its consequences in the fetus and newborn. Endocrine. 2002;19:43–55.
19. Bartels A, O’Donohue K. Cholesterol in pregnancy: a review of knowns and unknowns. Obstet Med. 2011;4:147–151.
20. Catov JM, Bodnar LM, Kip KE, Hubel C, Ness RB, Harger G, Roberts JM. Early pregnancy lipid concentrations and spontaneous preterm birth. Am J Obstet Gynecol. 2007;197:610.e611–617.
21. Enquobahrie DA, Williams MA, Butler CL, Frederick IC, Miller RS, Luthy DA. Maternal plasma lipid concentrations in early pregnancy and risk of pre eclampsia. Am J Hypertens. 2004;17:574–581.
22. Wiznitzer A, Mayer A, Novack V, Sheiner E, Glitzu H, Malhotra A, Novack L. Association of lipid levels during gestation with pre eclampsia and gestational diabetes mellitus: a population-based study. Am J Obstet Gynecol. 2009;201:482.e481–486.
23. Mosca L, Mochari H, Christian A, Berra K, Taubert K, Mills T, Burdick DA, Simpson SL. National study of women’s awareness, preventive action, and barriers to cardiovascular health. Circulation. 2006;113:525–534.
24. Nash IS, Mosca L, Blumenthal RS, Davidson MH, Smith SC, Pasternak RC. Contemporary awareness and understanding of cholesterol as a risk factor. Arch Intern Med. 2003;163:1597–1600.
25. ACOG Committee Opinion No. 736: optimizing postpartum care. American College of Obstetricians and Gynecologists. Obstet Gynecol. 2018;131:e140–e150.
26. Gidding SS, Champagne MA, de Ferrari SD, Defesche JC, Ito MK, Knowles JW, McCrindle B, Raal F, Rader D, Santos RD, et al. The agenda for familial hypercholesterolemia: a scientific statement from the American Heart Association. Circulation. 2016;132:2167–2192.
27. McGowan MP, Hosseini Dehkordi SH, Moriarty PM, Duell PB. Diagnosis and treatment of heterozygous familial hypercholesterolemia. J Am Heart Assoc. 2019;8:e013225. DOI: 10.1161/JAHA.119.013225.
28. Bursac Z, Gauss CH, Williams DK, Hosmer DW. Purposeful selection of variables in logistic regression. Source Code Biol Med. 2008;3:17.
29. Nelson K, Norris K, Mangione CM. Disparities in the diagnosis and pharmacologic treatment of high serum cholesterol by race and ethnicity: data from the Third National Health and Nutrition Examination Survey. Prev Med. 2012;55:9–16.
30. Frank AT, Zhao B, Jose PO, Azar KM, Fortmann SP, Palaniappan LP. Racial/ethnic differences in dyslipidemia patterns. Circulation. 2014;129:570–579.
31. Bucholz EM, Rodday AM, Kolor K, Khoury MJ, de Ferrari SD. Prevalence and predictors of cholesterol screening, awareness, and statin treatment among us adults with familial hypercholesterolemia or other forms of severe dyslipidemia (1999–2014). Circulation. 2018;137:2119–2200.
32. Centers for Disease Control and Prevention. Disparities in screening for and awareness of high blood cholesterol–United States, 1999–2002. MMWR Morb Mortal Wkly Rep. 2005;54:117–119.
33. Huang PY, Buring JE, Rider PM, Glynn RJ. Accuracy, awareness, and predictive validity of self-reported cholesterol in women. J Gen Intern Med. 2007;22:606–610.
34. Amrock SM, Duell PB, Knickelbine T, Martin SS, O’Brien EC, Watson KE, Mitri J, Kindt I, Shrader P, Baum SJ, et al. Health disparities among adult patients with a phenotypic diagnosis of familial hypercholesterolemia in the CASCADE-FH patient registry. Atherosclerosis. 2017;267:19–26.
35. Knowles JW, Rader DJ, Khoury MJ. Cascade screening for familial hypercholesterolemia and the use of genetic testing. JAMA Insights. 2017;318:381–382.
36. Goldberg AC, Hopkins PN, Toth PP, Ballantyne CM, Rader DJ, Robinson JG, Daniels SR, Gidding SS, de Ferrari SD, Ito MK, et al. Familial hypercholesterolemia: screening, diagnosis and management of pediatric and adult patients: clinical guidance from the National Lipid Association Expert Panel on Familial Hypercholesterolemia. J Clin Lipidol. 2011;5:S1–S8.
37. Gopal DJ, Smith CL, Adusumalli S, Soffer D, Denduluri S, Nemiroff R. Screening for hyperlipidemia in pregnant women: an underutilized opportunity for early risk assessment. J Am Coll Cardiol. 2019;73:14.
38. Sharma G, Lindley K, Grodzinsky A. Cardio-obstetrics. J Am Coll Cardiol. 2020;75:1355–1359.
39. Ehrenthal DB, Catov JM. Importance of engaging obstetrician/gynecologists in cardiovascular disease prevention. *Curr Opin Cardiol*. 2013;28:547–553.

40. Ehrenthal DB, Nunez AE, O’Neill E, Robertson-James C, Addo SF, Stewart A. The role of the obstetrician/gynecologist in the prevention of cardiovascular disease in women. *Womens Health Issues*. 2011;21:338–344.

41. Lewis B, Halm E, Marcus S, Korenstein D, Federman A. Preventive services use among women seen by gynecologists, general medical physicians, or both. *Obstet Gynecol Sci*. 2008;111:945–952.

42. Morgan M, Hr L, Schukin J. Obstetrician–gynecologists’ approach to well-woman care. *Obstet Gynecol Sci*. 2010;116:715–722.

43. Toleikyte I, Retterstol K, Leren TP, Iversen PO. Pregnancy outcomes in familial hypercholesterolemia. *Circulation*. 2011;124:1606–1614.

44. Amundsen AL, Khoury J, Iversen PO, Bergei C, Ose L, Tonstad S, Retterstol K. Marked changes in plasma lipids and lipoproteins during pregnancy in women with familial hypercholesterolemia. *Atherosclerosis*. 2006;189:451–457.
SUPPLEMENTAL MATERIAL
Data S1.

Participant Survey

Thank you for filling out this survey. Please answer all questions. When you are finished, please return the survey to the research assistant.

First, we will ask you some questions about cholesterol testing and your use of health care service before pregnancy.

1. What is your date of birth? _____ / ______ / ______ (MM / DD / YYYY)

2. Are you currently pregnant?
   □ Yes  □ No

   *If you answered “Yes” to the above question, please answer the following:

   3. How many weeks pregnant are you? ___________

4. Have you ever heard that high cholesterol is a risk factor for developing heart disease?
   □ Yes  □ No  □ I don’t know

5. Have you ever been told that you have high cholesterol?
   □ Yes  □ No  □ I don’t know

6. Have you ever had your cholesterol levels checked with a blood test?
   □ Yes  □ No  □ I don’t know

   *If you answered “Yes” to the above question, please answer the following:

   7. When did you last have them checked (approximately)?
      □ Within past year □ Within past 2 years
      □ Within past 5 years □ Within past 10 years
      □ Longer than 10 years ago

   8. Who ordered the test?
      □ Primary care or family medicine provider □ OB/GYN
      □ Cardiologist □ Pediatrician
      □ Other, please describe: ________________________________ □ I don’t know

   9. What were you told about the results?
      Cholesterol levels were:
      □ normal □ not normal
      □ borderline □ wasn’t told or I don’t remember

10. Does high cholesterol run in the family?
    □ Yes  □ No  □ I don’t know

    *If you answered “Yes” to the above question, please answer the following:

    11. Who in the family has high cholesterol?
        □ Mother  □ Father  □ Brother  □ Sister  □ Grandparent

12. Have you ever been on cholesterol lowering medication?
□ Yes □ No □ I don’t know

*If you answered “Yes” to the above question, please answer the following:*

13. Which cholesterol lowering medications have you taken?

□ Statins (Lipitor, Crestor) □ Ezetimibe (Zetia)
□ Bile Acid Sequestrants (Colestid) □ PSCK9 inhibitors (Repatha, Praluent)
□ Niacin □ Other, please describe: ____________________________

Next, we will ask you some questions about your personal medical history and your family history.

14. Is there a doctor or other health care provider that you see regularly for check-ups or health maintenance when you are not pregnant?
□ Yes □ No

*If you answered “Yes” to the above question, please answer the following:*

15. What kind of health care provider do you see?

□ Primary care, internal medicine, or family medicine provider □ OBGYN
□ Cardiologist □ Pediatrician
□ Other, please describe: ____________________________ □ I don’t know

16. Is this health care provider in the PENN system?
□ Yes □ No □ I don’t know

*If you answered “No” to the above question, please answer the following:*

17. When is the last time you saw a health care provider for a routine check-up or health maintenance visit?

□ More than 1 year ago □ More than 3 years ago
□ More than 5 years ago □ I don’t remember

18. Do you have any male first degree relatives (father, brother or son) who had a heart attack, stroke, or coronary artery disease that occurred before the age of 50 years?
□ Yes □ No □ I don’t know

19. Do you have any female first degree relatives (mother, sister, daughter) who had a heart attack, stroke, or coronary artery disease that occurred before the age of 60 years?
□ Yes □ No □ I don’t know

20. Have you ever had any of the following conditions during this pregnancy or a prior pregnancy?
□ Gestational diabetes □ Gestational hypertension
□ Preeclampsia

21. Have you ever delivered a baby prematurely (before 37 weeks gestation)?
□ Yes □ No

*If yes to above question:*

How many *weeks* pregnant were you when you delivered? __________

22. Do you *currently* smoke cigarettes or use tobacco most days of the week?
□ Yes □ No
If you answered “No” to the above question, please answer the following:
Did you smoke or use tobacco most days of the week before pregnancy?
□ Yes □ No

23. What was your weight prior to pregnancy? ________ (in pounds)

Next, we want to know your opinion about cholesterol screening in pregnancy.

Cholesterol levels are measured with a blood test. High cholesterol is a risk factor for developing heart disease. Unfortunately, many women do not receive the recommended screening for cholesterol during their reproductive years. We would like to know how you would feel about your OBGYN checking your cholesterol levels during early pregnancy to see if you are at risk. These results would not impact your pregnancy but might change your care after you deliver. For example, if you had high cholesterol, your OBGYN might be more likely to refer you to a primary care doctor to learn about ways to lower your cholesterol through healthy diet and exercise. In rare cases, the cholesterol level might be high enough for a referral to see a doctor specializing in cholesterol disorders.

Given this information, please respond to the following statement. Your answer is confidential and will not impact the care you receive from your doctors.

24. I would like my OBGYN to check my cholesterol levels during early pregnancy, at the same time that I am getting my blood drawn for other necessary tests.
□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

Finally, we want to ask you a few questions about your background.

25. What is your race?
□ White □ Black □ Asian □ Native American □ Multiracial □ Prefer not to answer

26. What is your ethnicity?
□ Hispanic □ Non-Hispanic □ Prefer not to answer

27. What is your highest level of education completed?
□ Less than 12th grade □ High school or GED □ Some college or associate degree
□ College graduate or above □ Prefer not to answer

28. What is your annual household income?
□ Less than $20,000 □ $20,000 - $49,999 □ $50,000 - $99,999 □ More than $100,000
□ Prefer not to answer

Thank you for completing the survey.
If you have any feedback for us, please provide write your comments below.
| Study Variables                                                      | Overall Population (N=200) | NH White | NH Black | Asian | Hispanic | Multiracial |
|---------------------------------------------------------------------|----------------------------|----------|----------|-------|----------|------------|
| **Sample, n (%)**                                                    |                            | 91 (45.5)| 68 (34.0)| 18 (9.0)| 12 (6.0) | 8 (4.5)     |
| **Age, mean (SD)**                                                  |                            | 32.2 (5.7)| 34.1 (5.0)| 29.6 (5.8)| 33.6 (4.5)| 30.3 (6.0)| 31.3 (6.5) |
| **Age Categories, y**                                               |                            | 18 – 34 | 133 (67.9)| 53 (58.9)| 56 (82.4)| 9 (50.0)| 10 (83.3)| 5 (62.5) | 35+ |
|                                                                     |                            | 63 (32.1)| 37 (41.1)| 12 (17.7)| 9 (50.0)| 2 (16.7)| 3 (37.5) |
| **Gestational age (weeks) at time of survey**                       |                            | 1 – 13  | 18 (9.3)| 10 (11.2)| 6 (9.0)| 1 (5.9)| 1 (8.3) | 0 (0.0) | 14 – 27 |
|                                                                     |                            | 78 (40.2)| 42 (47.2)| 22 (32.8)| 6 (35.3)| 5 (41.7)| 3 (33.3) |
|                                                                     |                            | 98 (50.5)| 37 (41.6)| 39 (58.2)| 10 (58.8)| 6 (50.0)| 6 (66.7) |
| **Education**                                                       |                            |          |          |        |          |          |
| High school / GED or lower                                          |                            | 40 (20.2)| 6 (6.6)| 28 (41.2)| 1 (5.6)| 3 (25.0)| 2 (22.2) |
| Some college or associate degree                                    |                            | 42 (21.2)| 10 (11.0)| 22 (32.4)| 3 (16.7)| 5 (41.7)| 2 (22.2) |
| College graduate or above                                           |                            | 116 (58.6)| 75 (82.4)| 18 (26.5)| 14 (77.8)| 4 (33.3)| 5 (55.6) |
| **Annual Household Income**                                         |                            |          |          |        |          |          |
| Less than $20,000                                                   |                            | 19 (11.7)| 3 (3.7)| 11 (21.6)| 1 (6.7)| 3 (30.0)| 1 (20.0) |
| $20,000 – $49,999                                                   |                            | 32 (19.8)| 3 (3.7)| 23 (45.1)| 3 (20.0)| 2 (20.0)| 1 (20.0) |
| $50,000 – $99,999                                                   |                            | 35 (21.6)| 15 (18.5)| 12 (23.5)| 4 (26.7)| 2 (20.0)| 2 (20.0) |
| More than $100,000                                                  |                            | 76 (46.9)| 60 (74.1)| 5 (9.8)| 7 (46.7)| 3 (30.0)| 1 (20.0) |
| **Usual Source of Non-Pregnancy Care**                              |                            |          |          |        |          |          |
| Yes                                                                 |                            | 172 (87.8)| 77 (85.6)| 63 (92.7)| 12 (66.7)| 11 (100.0)| 9 (100.0) |
| No                                                                  |                            | 24 (12.2)| 13 (14.4)| 5 (7.4)| 6 (33.3)| 0 (0.0)| 0 (0.0) |
| **Non-Pregnancy Usual Care Provider Type**                          |                            |          |          |        |          |          |
| Primary care, family medicine                                       |                            | 153 (90.0)| 71 (94.7)| 52 (82.5)| 10 (83.3)| 11 (100.0)| 9 (100.0) |
| OB/GYN                                                              |                            | 17 (10.0)| 4 (5.3)| 11 (17.5)| 2 (16.7)| 0 (0.0)| 0 (0.0) |
| **Family History of High Cholesterol**                             |                            |          |          |        |          |          |
| Yes                                                                 |                            | 67 (34.5)| 43 (47.8)| 11 (16.4)| 9 (52.9)| 2 (18.2)| 2 (22.2) |
| No                                                                  |                            | 95 (49.0)| 36 (40.0)| 40 (59.7)| 6 (35.3)| 8 (72.7)| 5 (55.6) |
| Unsure                                                              |                            | 32 (16.5)| 11 (12.2)| 16 (23.9)| 2 (11.8)| 1 (9.1)| 2 (22.2) |
| **Family History of Cardiovascular Disease**                        |                            |          |          |        |          |          |
| Yes                                                                 |                            | 32 (16.2)| 13 (14.3)| 11 (16.4)| 3 (16.7)| 2 (16.7)| 3 (33.3) |
| No                                                                  |                            | 156 (83.8)| 78 (85.7)| 56 (83.6)| 15 (83.3)| 10 (83.3)| 6 (66.7) |
| **Past OB History**                                                 |                            |          |          |        |          |          |
| Gestational diabetes                                               |                            | 17 (8.6)| 6 (6.6)| 6 (8.8)| 3 (16.7)| 1 (8.3)| 1 (11.1) |
| Gestational hypertension                                           |                            | 13 (6.6)| 7 (7.7)| 6 (8.8)| 0 (0.0)| 0 (0.0)| 0 (0.0) |
| Preeclampsia                                                       |                            | 18 (9.1)| 6 (6.6)| 10 (14.7)| 1 (5.6)| 1 (8.3)| 0 (0.0) |
| Premature birth (<37 weeks’ gestation)                             |                            | 17 (8.6)| 5 (5.5)| 10 (14.7)| 0 (0.0)| 1 (8.3)| 1 (11.1) |

* Frequencies may not add up to entire sample population (N=200) due to missing data based on race/ethnicity. GED, general education diploma; OB/GYN, obstetrician/gynecologist.
Table S2. Demographic and clinical characteristics associated with a prior lipid screening and an awareness of high cholesterol as a cardiovascular risk factor.

| Study Variables                             | Prior Lipid Screening | Awareness of High Cholesterol as Risk Factor |
|---------------------------------------------|-----------------------|---------------------------------------------|
|                                             | Yes (N = 118) | No / Unsure (N = 82) | P Value | Yes (N = 158) | No / Unsure (N = 42) | P Value |
| Age, y                                      |                     |                          |         |               |                          |         |
| 18 – 34                                     | 71 (53.4)           | 62 (46.6)                | 0.011   | 100 (75.2)    | 33 (24.8)               | 0.041   |
| 35+                                         | 47 (72.3)           | 18 (27.7)               |         | 57 (87.7)     | 8 (12.3)                |         |
| Gestational age (weeks) at time of survey   |                     |                          | 0.341   |               |                          | 0.702   |
| 1 – 13                                      | 9 (50.0)            | 9 (50.0)                |         | 13 (72.2)     | 5 (27.8)                |         |
| 14 – 27                                     | 43 (54.4)           | 36 (45.6)               |         | 62 (78.5)     | 17 (21.5)               |         |
| 28+                                         | 63 (63.6)           | 36 (36.4)               |         | 80 (80.8)     | 19 (19.2)               |         |
| Race/Ethnicity                              |                     |                          | 0.007   |               |                          | <0.001  |
| NH White                                    | 61 (67.0)           | 30 (33.0)               |         | 84 (92.3)     | 7 (7.7)                 |         |
| NH Black                                    | 29 (42.7)           | 39 (57.4)               |         | 45 (66.2)     | 23 (33.8)               |         |
| Asian                                       | 12 (66.7)           | 6 (33.3)                |         | 13 (72.2)     | 5 (27.8)                |         |
| Hispanic                                    | 10 (83.3)           | 2 (16.7)                |         | 9 (75.0)      | 3 (25.0)                |         |
| Multiracial                                 | 4 (44.4)            | 5 (55.6)                |         | 5 (55.6)      | 4 (44.4)                |         |
| Education                                   |                     |                          | 0.002   |               |                          | 0.006   |
| High school / GED or lower                  | 14 (35.0)           | 26 (65.0)               |         | 26 (65.0)     | 14 (35.0)               |         |
| Some college or higher                      | 25 (59.5)           | 17 (40.5)               |         | 30 (71.4)     | 12 (28.6)               |         |
| College graduate or above                   | 79 (67.0)           | 39 (33.1)               |         | 102 (86.4)    | 16 (13.6)               |         |
| Annual Household Income                     |                     |                          | 0.066   |               |                          | 0.003   |
| Less than $20,000                           | 9 (47.4)            | 10 (52.6)               |         | 11 (57.9)     | 8 (42.1)                |         |
| $20,000 – $49,999                           | 16 (50.0)           | 16 (50.0)               |         | 24 (75.0)     | 8 (25.0)                |         |
| $50,000 – $99,999                           | 22 (61.1)           | 14 (38.9)               |         | 29 (80.6)     | 7 (19.4)                |         |
| More than $100,000                          | 55 (72.4)           | 21 (27.6)               |         | 70 (92.1)     | 6 (7.9)                 |         |
| Usual Source of Care                        |                     |                          | 0.307   |               |                          | 0.030   |
| Yes                                         | 106 (60.9)          | 68 (39.1)               |         | 142 (81.6)    | 32 (18.4)               |         |
| No                                          | 12 (50.0)           | 12 (50.0)               |         | 15 (62.5)     | 9 (37.5)                |         |
| Usual Care Provider Type                    |                     |                          | 0.007   |               |                          | <0.001  |
| Primary care, family medicine               | 97 (63.0)           | 57 (37.0)               |         | 128 (83.1)    | 26 (16.9)               |         |
| OB/GYN                                      | 5 (29.4)            | 12 (70.6)               |         | 8 (47.1)      | 9 (52.9)                |         |
| Family History of High Cholesterol         |                     |                          | 0.239   |               |                          | 0.006   |
| Yes                                         | 45 (66.2)           | 23 (33.8)               |         | 57 (83.8)     | 11 (16.2)               |         |
| No                                          | 52 (54.2)           | 44 (45.8)               |         | 81 (84.4)     | 15 (15.6)               |         |
| Unsure                                      | 21 (65.6)           | 11 (34.4)               |         | 19 (59.4)     | 13 (40.6)               |         |
| Family History of CVD                       |                     |                          | 0.876   |               |                          | 0.300   |
| Yes                                         | 19 (57.6)           | 14 (42.4)               |         | 24 (72.7)     | 9 (27.3)                |         |
| No                                          | 98 (59.0)           | 68 (41.0)               |         | 134 (80.7)    | 32 (19.3)               |         |
| Past OB History                             |                     |                          | 0.310   |               |                          | 0.789   |
| Gestational diabetes                        | 12 (70.6)           | 5 (29.4)                |         | 13 (76.5)     | 4 (23.5)                |         |
| Gestational hypertension                    | 11 (84.6)           | 2 (15.4)                | 0.052   | 10 (76.9)     | 3 (23.1)                | 0.849   |
| Preeclampsia                                | 7 (38.9)            | 11 (61.1)               | 0.069   | 13 (72.2)     | 5 (27.8)                | 0.459   |
| Premature birth (<37 weeks’ gestation)      | 5 (29.4)            | 12 (70.6)               | 0.010   | 10 (58.8)     | 7 (41.2)                | 0.033   |

CVD, cardiovascular disease; GED, general education diploma; OB/GYN, obstetrician/gynecologist
Table S3. Lipid screening characteristics among pregnant women from data abstraction of electronic medical records stratified by non-Hispanic White and non-Hispanic Black racial/ethnic subgroups.

| Lipid Levels, mean (SD)† | Overall (N=194)* | NH White (N=35) | NH Black (N=12) | P-Value† |
|--------------------------|------------------|-----------------|-----------------|----------|
| Total cholesterol, mg/dL‡| 174.4 (28.5)     | 175.4 (26.4)    | 175.3 (34.5)    | 0.905    |
| LDL-C, mg/dL             | 96.7 (25.8)      | 96.0 (20.7)     | 109.5 (33.2)    | 0.125    |
| HDL-C, mg/dL             | 60.9 (13.4)      | 63.0 (13.7)     | 52.0 (9.7)      | 0.048    |
| Triglycerides, mg/dL     | 84.2 (40.8)      | 82.5 (40.7)     | 67.7 (26.1)     | 0.124    |

* Six participants with absence of electronic medical records
† P-value represents statistical comparison between NH White and NH Black subgroups
‡ Cholesterol levels from outlier (n=1) with suspected untreated familial hypercholesterolemia excluded from statistical analysis
SD, standard deviation; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol