

# Parity and Components of the Metabolic Syndrome Among US Hispanic/Latina Women

## Results From the Hispanic Community Health Study/Study of Latinos

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**Background**—Physiological adaptations occurring across successive pregnancies may increase the risk of adverse cardiovascular health outcomes in later life.

**Methods and Results**—The association between parity and metabolic syndrome was examined among 7467 Hispanic/Latina women of diverse backgrounds, aged 18 to 74 years, who participated in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) from 2008 to 2011. Metabolic syndrome components were defined according to American Heart Association/National Heart, Lung, and Blood Institute criteria and included abdominal obesity, elevated triglycerides, low high-density lipoprotein cholesterol, high blood pressure, and elevated fasting glucose. Logistic regression models estimated odds ratios (ORs) adjusting for sociodemographic, behavioral, and reproductive characteristics. At HCHS/SOL baseline, women reported none (21.1%), 1 (19.9%), 2 (25.7%), 3 (18.6%), 4 (8.8%), and  $\geq 5$  (5.9%) live births. When compared with women with 1 birth, those with 4 births had the highest odds of abdominal obesity (OR, 2.0; 95% confidence interval, 1.5–2.8) and overall metabolic syndrome (OR, 1.4; 95% confidence interval, 1.0–2.0) and those with  $\geq 5$  births had the highest odds of low high-density lipoprotein cholesterol (OR, 1.5; 95% confidence interval, 1.2–2.0) and elevated fasting glucose (OR, 1.6; 95% confidence interval, 1.1–2.4), after adjusting for age, background, education, marital status, income, nativity, smoking, physical activity, menopause, oral contraceptive use, hormone therapy, and field center. Further adjustment for percent body fat attenuated these associations. No associations were observed between parity and elevated triglycerides or high blood pressure.

**Conclusions**—Higher parity is associated with an increased prevalence of selected components of the metabolic syndrome among Hispanic/Latina women in the US. High parity among Hispanics/Latinas with a high prevalence of abdominal obesity suggests high risk for metabolic dysregulation. (*Circ Cardiovasc Qual Outcomes*. 2016;9:S62-S69. DOI: 10.1161/CIRCOUTCOMES.115.002464.)

**Key Words:** cohort studies ■ Hispanic Americans ■ metabolic syndrome X ■ parity ■ pregnancy

Cardiovascular disease (CVD) is a leading cause of morbidity and mortality among women in the United States. In 2013,  $\approx 365\,000$  US women died from heart disease and stroke.<sup>1</sup> Metabolic risk factors have been identified for CVD, including abdominal obesity, elevated triglycerides, low high-density lipoprotein (HDL) cholesterol, high blood pressure, and elevated fasting glucose; a combination of  $\geq 3$  of these risk factors is known as the metabolic syndrome (MetS).<sup>2</sup> The MetS is associated with an increased risk of adverse cardiovascular health outcomes, particularly among women.<sup>3,4</sup>

Lactation, hormonal contraceptive use, and polycystic ovary syndrome are factors unique to women that are associated with the MetS.<sup>4</sup> Menopause and pregnancy can also impact the prevalence and characteristics of the MetS.<sup>4</sup> Pregnancy, in particular, is a time when women experience physiological changes and are at risk of pregnancy-related complications, some of which are associated with a higher risk of adverse cardiovascular health outcomes in later life.<sup>5–8</sup> Physiological adaptations and complications occurring across successive pregnancies may be associated with an even higher

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### WHAT IS KNOWN

- Prior studies have conflicting results, with some suggesting a linear association between increasing parity and an increased prevalence of abdominal obesity and lower high-density lipoprotein cholesterol, and others suggesting no association between parity and waist circumference or high-density lipoprotein cholesterol.
- Several prior studies found no association between parity and elevated fasting glucose.

### WHAT THE STUDY ADDS

- Among Hispanic/Latina women, multiparity is associated with an increased prevalence of abdominal obesity, low high-density lipoprotein cholesterol, and elevated fasting glucose, after adjustment for sociodemographic, behavioral, and reproductive characteristics.
- Higher parity is not associated with an increased prevalence of elevated triglycerides or high blood pressure.
- Multiparity is associated with an increased prevalence of the overall metabolic syndrome, but the association may not be independent of percent body fat.

risk of adverse cardiovascular outcomes.<sup>8</sup> Previous studies have examined the association between parity and the MetS, but they have been limited by small sample sizes<sup>9–11</sup> and study populations that were predominantly of non-Hispanic background.<sup>10,12–17</sup> To our knowledge, no studies have examined the association between parity and the MetS in a US Hispanic/Latina population.

Hispanic/Latina women have a higher prevalence of the MetS than non-Hispanic women.<sup>18</sup> Between 2003 and 2006, the prevalence of the MetS was  $\approx 41\%$  among US Mexican American women when compared with  $32\%$  among non-Hispanic white women.<sup>18</sup> A more recent estimate of the age-standardized prevalence of the MetS among Hispanic/Latina women from 4 US cities was  $36\%$  ( $34.6\%–37.4\%$ ).<sup>19</sup> Latinos are also the fastest-growing minority population in the United States, and Hispanic/Latina women report higher fertility and birth rates than their non-Hispanic counterparts.<sup>20</sup> Thus, understanding the impact of parity on the MetS is important for informing preventive efforts to decrease the prevalence of metabolic and cardiovascular disorders in this population.

Our objective was to examine the association between parity and the prevalence of the 5 components of the MetS among a cohort of Hispanic/Latina women enrolled in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). We hypothesized that nulliparous (no prior live births) and multiparous (multiple live births) women would have a higher prevalence of each of the 5 components of the MetS than primiparous (one live birth) women, with a J-shaped association expected.

## Methods

### Study Population

The HCHS/SOL is a prospective, population-based cohort study of Hispanics/Latinos of diverse backgrounds, including individuals self-identifying as Cuban, Dominican, Mexican, Puerto Rican, Central American, and South American. The HCHS/SOL cohort was selected through a stratified multistage area probability sample in four US field centers (Bronx, Chicago, Miami, and San Diego). Census block groups were randomly selected from specified areas within each community, and households were randomly selected from each block group. At both stages, the study oversampled areas with a high concentration of Hispanics/Latinos, households with a Hispanic/Latino surname, and individuals aged 45 to 74 years. Individuals were excluded from the study if they were planning to move from the area within 6 months, unable to travel to the study site, or unable to complete the questionnaires. Pregnant women were asked to reschedule their visit after delivery. More details about the study design and methods have been previously described.<sup>21,22</sup> This study was approved by the Institutional Review Boards at the Albert Einstein College of Medicine, Northwestern University, San Diego State University, University of Miami, and the University of North Carolina at Chapel Hill. Informed consent was obtained for all study participants.

Between 2008 and 2011, 16415 men and women, aged 18 to 74 years, were recruited for participation. For this analysis, we excluded men ( $n=6580$ ). We also excluded 2368 women who did not meet at least 1 of the inclusion criteria, including those who were reportedly pregnant at baseline ( $n=14$ ), those with missing ( $n=207$ ) or implausible ( $n=5$ ) data for parity or missing data for any of the MetS components ( $n=133$ ), and those with self-reported or diagnosed diabetes mellitus at baseline ( $n=2102$ ). Diabetics were excluded to assess the relationship between parity and MetS in an otherwise healthy population. The final sample included 7467 women.

### Baseline Examination

Participants completed a baseline clinical examination for which they were asked to fast, abstain from smoking for at least 12 hours, and abstain from vigorous physical activity the morning of the visit.<sup>22</sup> This examination included assessments of anthropometrics, blood pressure, oral glucose tolerance, and several other biological measures. Weight (measured to the nearest 0.1 kg) and height (recorded to the nearest centimeter) were obtained and waist circumference (recorded to the nearest centimeter) was measured. Weight and body composition were measured using the Tanita scale, and percent body fat was provided by a bioelectrical impedance method. After a 5-minute rest period, 3 seated blood pressure measurements were obtained with an automatic sphygmomanometer; the second and third readings were averaged and used in this analysis.

Study participants provided blood samples according to standardized protocols, and samples were shipped to the HCHS/SOL Central Laboratory for processing. HDL-cholesterol (HDL-C) was measured using a direct magnesium/dextran sulfate method, and fasting plasma glucose was measured using a hexokinase enzymatic method (Roche Diagnostics, Indianapolis, IN). Serum triglycerides were measured on a Roche Modular P chemistry analyzer using a glycerol blanking enzymatic method (Roche Diagnostics). The assay methodologies are described in HCHS/SOL Manual 7a (<https://www2.csc.unc.edu/hchs/system/files/protocols-manuals/UNLICOMMMANual07AddendumCentralLaboratoryProceduresv1006222011.pdf>).

Participants completed interviewer-administered questionnaires with information collected about demographics, health behaviors, and medical history. They were also asked to report all prescription and nonprescription medications and supplements. To overcome language barriers, all questionnaires were offered in English or Spanish based on the participant's preference by bilingual staff who were centrally trained. All questionnaires were translated by a certified service using culturally sensitive translation to ensure the use of language that could be interpreted correctly by all Hispanic/Latino backgrounds,

and pilot tested at all sites. Among the 7467 women included in our analysis, 80.3% (n=5999) preferred Spanish questionnaires.

## Measures

### Parity

Parity was defined as the number of prior live births as reported by women on the interviewer-administered questionnaire. For this analysis, parity was categorized as: none (nulliparity), 1, 2, 3, 4, and  $\geq 5$  (grand-multiparity) prior live births. For secondary analyses, parity was modeled as a continuous measure.

### Components of the MetS

The components of the MetS were classified according to the American Heart Association/National Heart, Lung, and Blood Institute 2009 Joint Scientific Statement<sup>2</sup> and included (1) abdominal obesity (waist circumference,  $\geq 88$  cm); (2) elevated triglycerides ( $\geq 150$  mg/dL); (3) low HDL-C ( $< 50$  mg/dL); (4) high blood pressure ( $\geq 130$  mm Hg systolic or  $\geq 85$  mm Hg diastolic or use of antihypertension medications); and (5) elevated fasting glucose ( $\geq 100$  mg/dL or use of antidiabetic medications). A combination of  $\geq 3$  of these factors comprised the overall MetS.

### Covariates

Women reported their age, Hispanic/Latino background, years of education (categorized as  $< 12$ , 12, or  $> 12$  years), marital status, annual household income (categorized as  $< \$20\,000$ ,  $\$20\,000$ – $\$40\,000$ ,  $\$40\,000$ – $\$75\,000$ ,  $> \$75\,000$ ), and country of birth on the interviewer-administered questionnaire. Participants also reported current smoking status, physical activity (minutes per hour categorized as meeting the US Department of Health and Human Services guidelines<sup>23</sup> if they participated in the equivalent of  $\geq 150$  minutes of moderate-intensity activity or  $\geq 75$  minutes of vigorous-intensity activity), and reproductive history (menopausal status, history of oral contraceptive use, and current hormone therapy).

## Statistical Analysis

Descriptive analyses were conducted to examine participant characteristics by categories of parity at baseline. All reported means and prevalence estimates were weighted to account for the probability of selection and to partially adjust for differential nonresponse bias. Prevalence estimates of overall MetS and its components were estimated by parity using predicted marginals from logistic regression models and adjusted for weighted mean age in the analytic sample. Odds ratios (OR) and 95% confidence intervals (CI) were estimated from logistic regression models to assess the association between parity and MetS. Separate models were examined for each component of MetS and for overall MetS with several adjustments considered, including model 1 (unadjusted), model 2 (age), model 3 (age, Hispanic/Latino background, education, marital status, income, nativity, smoking, physical activity, menopausal status, oral contraceptive use, hormone therapy, and field center), and model 4 (covariates from model 3 plus percent body fat). Model 4 was conducted to estimate the direct effect of parity on MetS independent of body fat because obesity is hypothesized to drive this association. Several coding strategies were used to assess the shape of the association between age and MetS. The effect of age was found to be linear for each component of the MetS and overall MetS, thus age was treated as a continuous variable for all adjusted analyses.

One prior live birth was chosen as the reference group to assess the hypothesis that there is a J-shaped association between parity and MetS. Women with no prior live births include those with a history of infertility or other reproductive issues as well as those who did not intend to have children. Conditions that contribute to infertility may be associated with risk factors for MetS, thus potentially increasing the prevalence of MetS among nulliparous women. Analyses were performed using SAS 9.3 software (SAS Institute, Cary, NC) or SUDAAN software Release 11 (RTI International, Research Triangle Park, NC).

## Results

### Study Population

At HCHS/SOL baseline, the mean number of prior live births per woman was 1.97 (SE, 0.03) and ranged from 0 to 22. Women reported none (21.1%), 1 (19.9%), 2 (25.7%), 3 (18.6%), 4 (8.8%), and  $\geq 5$  (5.9%) prior live births. High percentages of women with  $\geq 5$  live births (ie, grand multiparous women) did not complete high school, had a low family income, were overweight or obese, not born in the United States, postmenopausal, and ever used oral contraceptives (Table). More than half of these women were of Mexican background (55.2%). Conversely, high percentages of women with 1 live birth completed some college, had a higher income, were normal weight, US born, and premenopausal. Less than one third of these women were of Mexican background (31.0%). On average, women with  $\geq 5$  live births were the oldest and those with no prior live births were the youngest. Percent body fat, on average, was highest among those with 4 and  $\geq 5$  live births and lowest among those with no prior live births.

### Age-Adjusted Prevalence of MetS Components by Parity

Among women at HCHS/SOL baseline, abdominal obesity was the most prevalent MetS component with age-adjusted prevalence estimates ranging from 61% (SE, 2.3) among those with no live births to 84% (SE, 2.0) among those with  $\geq 4$  live births (Figure 1). Elevated fasting glucose was the least prevalent component with age-adjusted prevalence estimates ranging from 12% (SE, 1.3) among women with 1 live birth to 21% (SE, 2.4) among those with  $\geq 5$  live births. Among the parity groups, women with no live births had the lowest prevalence and those with  $\geq 5$  live births had the highest prevalence of abdominal obesity, elevated triglycerides, and low HDL-C while adjusting for age. Similar patterns were observed for the overall MetS.

### Parity and MetS Components

When compared with women with 1 live birth, those with 4 live births had the highest odds of abdominal obesity (OR, 2.0; 95% CI, 1.5–2.8) and overall MetS (OR, 1.4; 95% CI, 1.0–2.0) and those with  $\geq 5$  live births had the highest odds of low HDL-C (OR, 1.5; 95% CI, 1.2–2.0) and elevated glucose (OR, 1.6; 95% CI, 1.1–2.4), after adjusting for age, Hispanic/Latino background, education, marital status, income, nativity, smoking, physical activity, menopausal status, oral contraceptive use, hormone therapy, and field center (Figure 2; specific ORs and 95% CI for all models are located in Table I in the Data Supplement). Women with no live births had the lowest odds of abdominal obesity (OR, 0.7; 95% CI, 0.5, 0.9). Further adjustment for percent body fat attenuated the associations, including low HDL-C (OR, 1.5; 95% CI, 1.1, 2.0) and elevated fasting glucose (OR, 1.5; 95% CI, 1.0, 2.2), and the associations of parity with abdominal obesity and overall MetS were no longer statistically significant. No associations were observed between parity and elevated triglycerides or high blood pressure.

When assessing parity as a continuous measure, a dose-response effect was observed between increasing number of

**Table. Characteristics of Hispanic/Latina Women by Parity (n=7467), Hispanic Community Health Study/Study of Latinos, 2008–2011**

	No Prior Live Births (n=1103)	1 Prior Live Birth (n=1205)	2 Prior Live Births (n=1968)	3 Prior Live Births (n=1685)	4 Prior Live Births (n=825)	≥5 Prior Live Births (n=681)
Overall, %	21.1	19.9	25.7	18.6	8.8	5.9
Age, y, mean (SE)	27.3 (0.4)	36.1 (0.5)	42.7 (0.5)	45.6 (0.6)	46.1 (0.9)	52.1 (0.8)
Hispanic/Latino background, %						
Central American	9.6	10.3	11.3	10.9	12.9	12.2
Cuban	12.6	23.6	18.8	7.4	3.9	3.8
Dominican	9.4	9.5	8.9	12.9	10.3	6.2
Mexican	40.7	31.0	37.3	45.3	50.1	55.2
Puerto Rican	11.5	12.5	14.7	15.3	15.9	14.4
South American	9.5	9.2	7.2	5.4	5.3	5.3
Mixed	6.6	3.9	1.9	2.9	1.7	2.9
Education, % (SE)						
Less than high school	14.5 (1.4)	22.5 (2.0)	27.8 (1.7)	39.0 (2.2)	46.7 (3.1)	71.4 (2.5)
High school graduate	28.5 (1.7)	28.9 (2.2)	28.3 (1.6)	23.5 (1.5)	28.8 (3.3)	13.5 (1.8)
At least some college	57.1 (1.9)	48.5 (2.2)	43.9 (1.9)	37.5 (2.2)	24.4 (2.4)	15.1 (1.9)
Married, % (SE)	22.4 (1.8)	51.0 (2.2)	56.8 (1.7)	57.5 (2.0)	54.6 (3.0)	51.5 (2.7)
US Born, % (SE)	42.8 (2.2)	21.8 (1.9)	16.8 (1.5)	13.1 (1.2)	17.9 (3.4)	12.2 (1.8)
Annual family income, % (SE)						
<\$20 000	30.3 (1.8)	47.3 (2.0)	46.3 (1.8)	48.9 (2.2)	49.6 (3.0)	55.9 (2.8)
\$20 000–\$40 000	31.6 (2.0)	29.4 (2.1)	29.1 (1.5)	30.1 (2.0)	29.3 (2.5)	24.4 (2.6)
\$40 000–\$75 000	17.8 (2.0)	9.8 (1.2)	12.2 (1.0)	10.2 (1.0)	8.2 (1.4)	4.5 (1.1)
>\$75 000	5.3 (0.8)	4.1 (0.8)	4.0 (0.8)	4.1 (1.6)	2.0 (1.0)	0.7 (0.4)
Not reported	15.1 (1.4)	9.4 (1.2)	8.5 (0.9)	6.8 (0.8)	10.9 (1.8)	14.5 (1.9)
Smoker, % (SE)	16.1 (1.7)	17.3 (1.8)	15.8 (1.2)	15.2 (1.2)	21.4 (3.4)	14.4 (1.9)
Body mass index, % (SE)						
Underweight	4.6 (1.0)	1.6 (0.4)	0.6 (0.3)	0.3 (0.2)	0.2 (0.1)	1.8 (1.3)
Normal weight	39.7 (2.1)	27.5 (2.0)	21.5 (1.4)	18.2 (1.3)	11.2 (1.7)	12.5 (1.9)
Overweight	25.7 (1.8)	35.0 (2.2)	39.4 (1.7)	38.5 (2.0)	37.1 (2.9)	37.3 (2.7)
Obese	30.0 (2.0)	35.9 (2.3)	38.6 (2.0)	43.0 (2.0)	51.6 (3.1)	48.4 (2.8)
Percent body fat, mean (SE)	33.2 (0.5)	36.9 (0.4)	38.1 (0.3)	38.7 (0.3)	40.3 (0.5)	39.6 (0.4)
Meets 2008 HHS PA guidelines, % (SE)	68.2 (1.9)	61.3 (2.1)	57.4 (1.7)	60.2 (2.0)	61.3 (2.7)	52.9 (2.6)
Postmenopausal, % (SE)	6.4 (0.8)	17.8 (1.4)	27.7 (1.7)	36.1 (2.0)	34.5 (2.8)	50.6 (2.9)
Hysterectomy, % (SE)	2.6 (0.5)	7.2 (1.4)	9.9 (0.9)	13.6 (1.3)	15.5 (1.9)	15.4 (1.9)
Ever used oral contraceptives, % (SE)	42.7 (2.1)	63.5 (2.1)	65.7 (1.6)	65.8 (2.0)	68.6 (2.7)	61.9 (2.7)
Current hormone therapy use, % (SE)	2.3 (0.8)	1.7 (0.5)	3.0 (0.5)	2.3 (0.4)	2.5 (0.7)	2.6 (0.7)

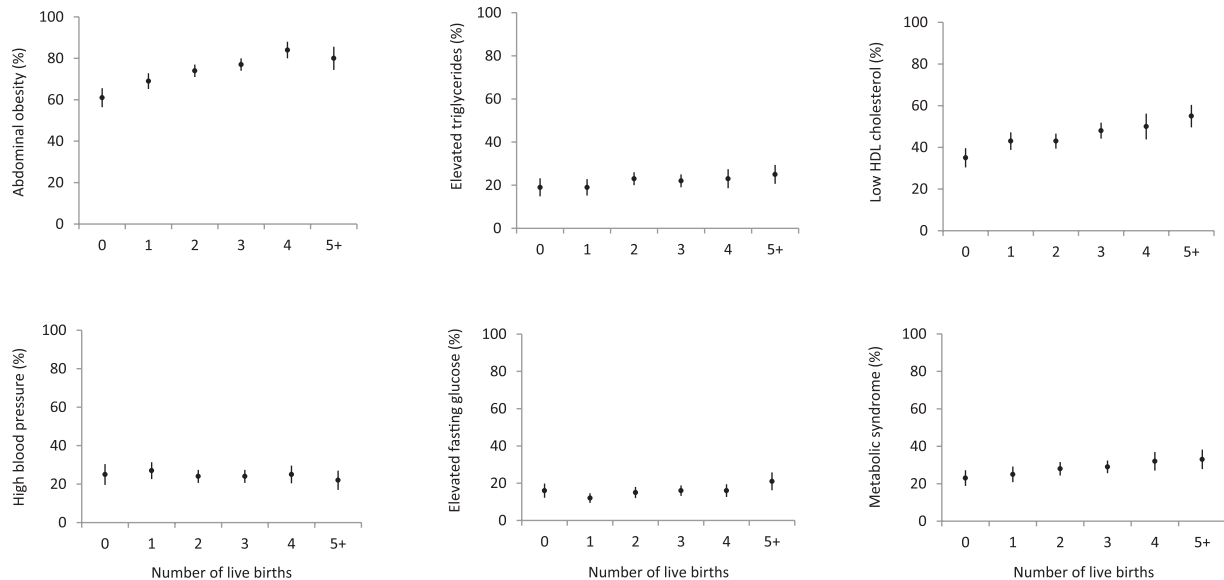
All values are percentages (SE) except age and percent body fat, which are reported as mean (SE); all percentages (with the exception of Hispanic/Latino background) and means are weighted for study design and nonresponse. HHS indicates U.S. Department of Health and Human Services; and PA, self-reported physical activity.

live births and both abdominal obesity and low HDL-C. For each additional birth (ie, an increase of 1 birth in the exposure measure), the estimated ORs of both abdominal obesity and low HDL-C were 1.1 (95% CI, 1.0, 1.2) after adjusting for all covariates in model 4. A dose–response effect was not observed between number of live births and the prevalence of elevated triglycerides, high blood pressure, elevated fasting glucose, or overall MetS.

To further rule out confounding by age, we conducted a sensitivity analysis restricted to women aged ≥50 years. The results were similar, with the exception of low HDL-C, fasting

glucose, and abdominal obesity. Women with ≥5 live births had even higher odds of low HDL-C than those with no prior live births (OR, 2.2; 95% CI, 1.4–3.2), and the associations between parity and fasting glucose were attenuated and no longer statistically significant (Table II in the Data Supplement). In addition, after adjustment for sociodemographic, behavioral, and reproductive characteristics, women with no live births had higher odds of abdominal obesity than those with 1 live birth (OR, 1.8; 95% CI, 0.9–3.4), but the results were not statistically significant. Adjustment for percent body fat further attenuated this association (OR, 1.3; 95% CI, 0.6–2.8).





**Figure 1.** Age-adjusted prevalence (95% confidence interval) of metabolic syndrome components by parity (n=7467), Hispanic Community Health Study/Study of Latinos (HCHS/SOL) 2008 to 2011. Age adjusted at 39.6 y (weighted mean age in the analytic sample). Abdominal obesity (waist circumference  $\geq 88$  cm), elevated triglycerides ( $\geq 150$  mg/dL), low high-density lipoprotein cholesterol ( $< 50$  mg/dL), high blood pressure ( $\geq 130$  mm Hg systolic or  $\geq 85$  mm Hg diastolic or use of antihypertension medications), elevated fasting glucose ( $\geq 100$  mg/dL or use of antidiabetic medications), and overall metabolic syndrome (a combination of  $\geq 3$  components).

## Discussion

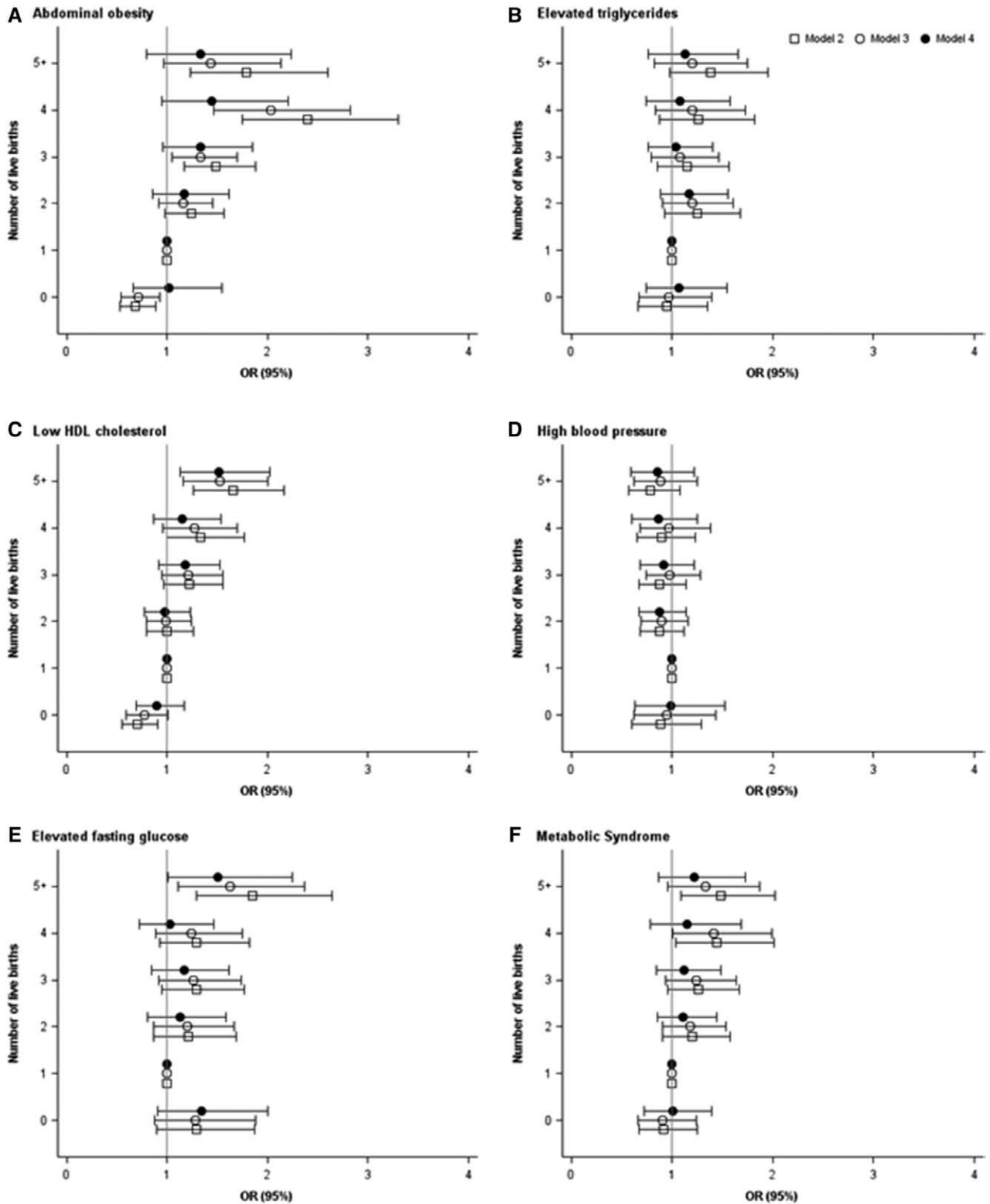
To our knowledge, this is the first study to examine the association between parity and MetS in a US Hispanic/Latina population. Multiparity was associated with an increased prevalence of selected components of the MetS, particularly abdominal obesity, low HDL-C, and elevated fasting glucose, after adjustment for sociodemographic, behavioral, and reproductive characteristics. In contrast to our hypothesis, a linear association was observed between parity and both abdominal obesity and low HDL-C such that each additional live birth increased the odds of these MetS components by 10%. With the exception of abdominal obesity, these associations persisted after further adjustment for percent body fat.

Prior studies of the association between parity and individual components of the MetS have conflicting results. Although our results are similar to those from studies among Chinese and US populations that found a linear association between increasing parity and both higher waist circumference<sup>13</sup> and an increased prevalence of abdominal obesity (waist circumference,  $> 88$  cm),<sup>12</sup> respectively, they are in contrast to studies of Bangladeshi<sup>17</sup> and Iranian<sup>15</sup> women where no association was observed between parity and waist circumference, after adjustment for similar sociodemographic, lifestyle, and reproductive factors. Similarly, a few prior studies also noted a linear association between increasing parity and lower HDL-C,<sup>12,13,15</sup> whereas others found no association.<sup>16,17</sup> In contrast to our findings, most prior studies did not find an association between parity and elevated fasting glucose,<sup>12,13,17</sup> and a few studies observed a linear association between increasing parity and elevated triglycerides.<sup>12,15,16</sup> The most consistent finding across studies, including the present study, was the lack of association observed between parity and blood pressure.<sup>12,13,15,16</sup> Overall, these results suggest that parity may

alter women's metabolic profiles. However, the differences in results across prior studies indicate that specific MetS components may be more or less susceptible to change depending on the population.

Multiparity of  $\geq 4$  live births was associated with a higher prevalence of the overall MetS in this population of Hispanic/Latina women; as expected, this association was attenuated and no longer statistically significant after adjustment for percent body fat. This finding is consistent with prior studies among other racial and ethnic groups that observed significant relationships between increasing parity and overall MetS,<sup>12,13,15,16</sup> including statistically significant variations by history of gestational diabetes mellitus.<sup>14</sup> Adjustment for body mass index attenuated these earlier findings, and the associations were no longer statistically significant for some.<sup>12,15</sup> These results suggest that the relationship between parity and MetS may not be independent of obesity, thus adiposity or weight may mediate this association.

A combination of biological changes and lifestyle factors associated with childbearing may explain the associations that were observed. During pregnancy, women experience physiological changes, such as insulin resistance, dyslipidemia, fat accumulation, inflammation, and weight gain.<sup>24,25</sup> Although most of these alterations revert to the nonpregnant state after delivery, some changes could persist and even accumulate across successive pregnancies.<sup>24,26,27</sup> In addition, changes in lifestyle risk factors (eg, physical activity and stress) and the cumulative burden of caring for a larger family may impact the prevalence of the MetS and its components. In our study, adjustment for behavioral factors simultaneously with other sociodemographic and reproductive factors attenuated the results slightly. Additional assessment of the association between parity and MetS among HCHS/SOL men could



**Figure 2.** Adjusted odds ratios (ORs) for the association between parity and components of the metabolic syndrome (MetS;  $n=7467$ ), Hispanic Community Health Study/Study of Latinos (HCHS/SOL) study, 2008 to 2011. Model 2 (adjusted for age), model 3 (adjusted for age, Hispanic/Latino background, education, marital status, income, nativity, smoking, physical activity, menopausal status, oral contraceptive use, hormone therapy, and field center), and model 4 (adjusted for covariates from model 3 plus percent body fat). Abdominal obesity (**A**; waist circumference  $\geq 88$  cm), elevated triglycerides (**B**;  $\geq 150$  mg/dL), low high-density lipoprotein (HDL) cholesterol (**C**;  $< 50$  mg/dL), high blood pressure (**D**;  $\geq 130$  mm Hg systolic or  $\geq 85$  mm Hg diastolic or use of antihypertension medications), elevated fasting glucose (**E**;  $\geq 100$  mg/dL or use of antidiabetic medications), and overall metabolic syndrome (**F**; a combination of  $\geq 3$  components).

provide further insight into the role of lifestyle factors in the prevalence of the MetS in this population.

Pathogenic mechanisms of the MetS likely differ across racial and ethnic subgroups.<sup>28</sup> In the United States, Hispanic women are disproportionately affected by the MetS<sup>18</sup> and have a higher prevalence of overweight and obesity than non-Hispanic white women.<sup>29</sup> They also have more children and larger families than non-Hispanics.<sup>20</sup> Among Hispanic/Latina women in the HCHS/SOL Study, abdominal obesity was the most prevalent MetS component and was highest among women with at least 4 prior live births, whereas elevated fasting glucose was the least prevalent MetS component across all parity categories. High parity and a high prevalence of abdominal obesity among these women may suggest a context of high risk for metabolic dysregulation. A better characterization of the links between pregnancy, adiposity, and body fat distribution is needed to further assess these associations.

### Strengths and Limitations

Overall, this study expands on prior studies by examining parity and MetS in a large Hispanic/Latina population, while also assessing this association independent of body fat. The strengths of this study include the large, diverse cohort recruited from HCHS/SOL field centers that are located in cities with large Hispanic/Latino populations, thus allowing for a good representation of various backgrounds among participants. This study also measured anthropometrics and collected detailed information on many biological and behavioral measures, including percent body fat, which to our knowledge was not collected or assessed in prior studies.

This study has limitations. Like most prior studies of parity and MetS, the cross-sectional design limits the ability to establish temporality and assess changes in biological and lifestyle risk factors over time. The HCHS/SOL study lacked information on pregnancy-related complications, including diabetes mellitus and preeclampsia, which have been found to be associated with adverse cardiovascular health outcomes in later life<sup>7,30</sup> and may contribute to the associations that were observed. Information on breastfeeding history was not collected in HCHS/SOL; however, breastfeeding rates among Latina women are higher than among other racial and ethnic groups.<sup>31</sup> Lactation may reverse cardiometabolic adaptations occurring during pregnancy and fat accumulation,<sup>32,33</sup> thus lowering the risk of MetS<sup>12,34</sup> and attenuating the association between parity and MetS.<sup>15</sup> This study also lacked information on age at first live birth, which has been found to be associated with a decreased risk of MetS.<sup>10</sup> There also may be additional unmeasured risk factors associated with multiparity and MetS (eg, stress). Residual confounding by these factors may have weakened the associations that were observed. In addition, the generalizability of this study to other racial and ethnic groups may be limited.

### Conclusions

Given the expected growth of the Hispanic/Latino population in the United States, preventive action is needed to reduce metabolic and CVD risks in this population, particularly women. Our study highlights the importance of multiparity as a potential risk factor for developing selected components of

the MetS that can ultimately impact the risk of CVD in later life. The 2011 American Heart Association's Guidelines for CVD Prevention in Women<sup>35</sup> recommend obtaining information on pregnancy history when evaluating cardiovascular risk for women. Although these guidelines highlight the importance of capturing a detailed history of pregnancy complications, information on the number of prior live births may also be informative. Early identification of high-risk women based on their pregnancy history provides an opportunity for both primordial and primary prevention of CVD.

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### Disclosures

Drs Ni, Sotres-Alvarez, and Vladutiu had full access to the study data and take responsibility for the integrity of the data and accuracy of analyses. All authors have reviewed and approved the final article. The other authors report no conflicts.

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## Parity and Components of the Metabolic Syndrome Among US Hispanic/Latina Women: Results From the Hispanic Community Health Study/Study of Latinos

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