The prevalence of diabetes in pregnancy (type 2 diabetes and gestational diabetes mellitus [GDM]) is growing in the United States and globally, making it an international public health priority (1–8). Women who develop GDM (i.e., glucose intolerance first detected during pregnancy [9]) are more than seven times as likely to develop type 2 diabetes than women who have had a normoglycemic pregnancy (10,11). Another complication in pregnancy is prenatal depression (PND), estimated to occur in 5% (12,13) to 51.4% (13,14) of the general population. Rates of these two medical complications are high among Latinas in the United States—an important fact because Latinas are the fastest-growing ethnic minority group (15), have the highest fertility rate in the United States (16), experience high rates of PND (32% [17]), and are at least twice as likely to develop diabetes in pregnancy than white women.
poorer SRH during pregnancy and also shown an association between of mortality (53). Prior studies have that is consistent with objective factors are particularly important to examine given the complex stressors and risk factors immigrant (58) and more acculturated Latinas (59) experience.

Given the predictive role of SRH and the long-term implications of poor health in pregnancy for maternal and child outcomes, it is important to explore the effects of diabetes and PND on SRH in prenatal Latinas. Yet, these associations have not been well explored. To address this gap in the literature, we tested the association between diabetes and PND and explored whether SRH was associated with these two health conditions in a sample of 34 Latinas enrolled in their third trimester of pregnancy. Because the relationship between PND and diabetes may be moderated by key demographic characteristics, we also explored associations between immigrant status, age, education, income, marital status, employment, and our outcomes of interest. This work extends prior research conducted with Latinas (60,61) by exploring associations between two important perinatal health factors (e.g., diabetes and depression), maternal characteristics, and SRH.

Methods
We used data from SEPAH Latina (Study of Exposure to Stress, Postpartum Mood, Adverse Life Events, and Hormonal Function Among Latinas), which collected health information from 34 Latina women from their third trimester of pregnancy to 8 weeks postpartum between July 2013 and April 2014 (see Lara-Cinisomo et al. [62] for study details). The study was approved by the University of North Carolina Chapel Hill institutional review board. All participants gave written informed consent. Interviews were conducted in Spanish or English, and all women were compensated for their participation.

Measures
Demographic information, self-reported medical conditions, and medication use were collected at enrollment. Depression status was determined using the Edinburgh Postnatal Depression Scale (EPDS), a reliable measure of prenatal depressive symptoms (63); a score >10 indicated PND (64). The EPDS was validated with prenatal (65) and Spanish-speaking Latinas (66).

SRH was determined from answers to two social comparison questions in two time periods: “Compared to other people your age, how would you describe the state of your physical health during the year before your pregnancy?” or “Compared to other people your age, how would you describe the state of your physical health since you’ve been pregnant?” Responses were chosen from a five-point Likert scale (poor to excellent) (67).

Data Analysis
Participant characteristics were summarized using descriptive statistics. Using SPSS 23 (IBM, Armonk, N.Y.), Fisher exact tests were used to determine associations between dichotomous variables (e.g., education, diabetes status, and PND status), and \( \chi^2 \) tests determined associations between categorical variables (e.g., SRH and type of medication). Nonparametric tests for paired data determined differences in pre-pregnancy and pregnancy SRH. Binary logistic regressions were used to determine the effect of diabetes on PND. Ordinal logistic regressions were implemented to test associations between SRH during pregnancy (dependent variable) and diabetes status (e.g., any diabetes and GDM). We also controlled for PND, pre-pregnancy SRH, and demographic characteristics to determine the unique contributing effect.
Results
Table 1 summarizes descriptive statistics and shows that 26.5% of women reported a diagnosis of diabetes, 14.7% reporting a diagnosis of GDM, 76.7% were overweight or obese, and 32.4% had PND. Less than one-fourth (23.5%) rated their pre-pregnancy health as fair or poor, but this proportion nearly doubled during pregnancy (41.2%). Results show that SRH was significantly lower during pregnancy compared to pre-pregnancy ($P = 0.022$). No significant associations were found between demographic characteristics, diabetes status (any diabetes or GDM), any SRH, or PND.

Among women with any type of diabetes (type 2 diabetes or GDM) during pregnancy, 33% had PND, but this proportion was higher among women with GDM (40%). Results from the logistic regression indicated that there was no significant association between any diabetes or GDM and PND (Table 2). Pregnancy SRH was significantly associated with PND [$\chi^2$ (df 4, $n = 34$) = 12.40, $P = 0.015$]. There were significant differences in pre-pregnancy [$H(1) = 5.266, P = 0.022$] and marginal differences in pregnancy [$H(1) = 7.761, P = 0.055$] SRH by PND status. There were also significant differences in pre-pregnancy [$H(1) = 6.021, P = 0.014$] and pregnancy [$H(1) = 7.251, P = 0.007$] SRH by any type of diabetes. Differences in pregnancy SRH by GDM status were also significantly different [$H(1) = 4.317, P = 0.038$]; pre-pregnancy ratings differed only marginally [$H(1) = 2.780, P = 0.095$].

Results from the ordinal logistic regressions indicated that there was a significant and negative association between any diabetes and pregnancy SRH ($P = 0.021$) (see Model 1, Table 4). Given our interest in the association between diabetes status and pregnancy SRH, individual predictors were added to the primary model. Results revealed that PND was negatively associated with pregnancy SRH ($P = 0.002$); the effect of any diabetes on pregnancy SRH remained statistically significant ($P = 0.002$) (see Model 2, Table 3). Similar results were observed for

### Table 1. Descriptive Statistics of Study Participants ($n = 34$)

| Immigrant status | 85.3 (29) |
|------------------|-----------|
| U.S.-born        | 14.7 (5)  |
|                  |           |
|                  |           |
| Marital status   |           |
| Single           | 26.5 (9)  |
| Married or cohabitating | 73.5 (25) |
|                  |           |
| Education level  |           |
| Less than high school | 55.9 (19) |
| High school or more | 44.1 (15) |
|                  |           |
| Employment       |           |
| Unemployed       | 79.4 (27) |
| Employed full-time | 20.6 (7)  |
|                  |           |
| Annual household income |       |
| <$20,000         | 50.0 (17) |
| $>20,000         | 41.2 (14) |
| Did not know     | 08.8 (3)  |
|                  |           |
| Diabetes diagnosis |         |
| Any type         | 26.5 (9)  |
| None             | 73.5 (25) |
| Gestational      | 14.7 (5)  |
| Non-gestational  | 85.3 (29) |
|                  |           |
| Medication/vitamin use |       |
| Diabetes-related | 23.5 (8)  |
| Other medications or prenatal vitamins | 47.0 (16) |
| None reported    | 23.5 (8)  |
| Missing          | 5.9 (2)   |
|                  |           |
| Prenatal depression status |      |
| Depressed        | 32.4 (11) |
| Not depressed    | 67.6 (23) |
|                  |           |
| BMI              |           |
| Underweight or normal (BMI ≤24.9 kg/m²) | 23.3 (7) |
| Overweight or obese (BMI ≥25.0 kg/m²) | 76.7 (23) |
|                  |           |
| Pre-pregnancy self-rated health |       |
| Poor             | 0 (0)     |
| Fair             | 23.5 (8)  |
| Good             | 20.6 (7)  |
| Very good        | 35.3 (12) |
| Excellent        | 20.6 (7)  |

TABLE CONTINUED ON P. 162 →
GDM (see Model 2, Table 4). Adding pre-pregnancy SRH to the model testing the effect of diabetes (any diabetes or GDM) on pregnancy SRH rendered its effect nonsignificant (see Model 3, Tables 3 and 4); pre-pregnancy SRH ratings were significantly associated with pregnancy SRH. The final models in Tables 3 and 4 show that diabetes status was significantly and negatively associated with pregnancy SRH after controlling for PND and pre-pregnancy SRH, which was also statistically significant with the exception of “good” ratings in the any diabetes model. Depressive characteristics did not yield any significant effects.

**Discussion**

Close to one in three women in our sample reported diabetes, a higher proportion than the general prenatal population (68). No significant associations were found between demographic characteristics, diabetes, and PND, possibly because this was a rather homogenous group. We did not find an association between diabetes and PND, which supports previous findings (69,70). A possible explanation might be that women in our study had high self-efficacy and felt they were successfully managing their disease. The majority of women with diabetes were taking diabetes-related medication (Table 1), which we hypothesize might increase confidence or self-efficacy and reduce the potential negative effects of diabetes status on their mental health because they are actively managing their condition. There is evidence to suggest that diabetes self-care and management is associated with self-efficacy and better mental health outcomes (71,72). It will be important to test our hypothesis with a larger sample of prenatal Latinas diagnosed with diabetes. However, PND was significantly associated with pregnancy SRH.

On average, participants rated their pregnancy health worse than pre-pregnancy health, suggesting that women felt worse during gestation. Others have found a similar trend, with the proportion of poor or fair SRH increasing in the third trimester (55). This shift in their perception, from good health pre-pregnancy to poorer health in pregnancy, might be an expression of pregnancy-related issues that were not assessed in this study, including poor sleep and uncomfortable weight gain, or risk factors, such as substance and/or tobacco use and economic hardship (55).

Similar to previous studies (54,55), we found that women with PND and diabetes rated their health significantly worse than individuals without these conditions. To further explore these associations, we tested the effect of PND and diabetes on pregnancy SRH and found a significant and negative association. To determine the effect of pre-pregnancy SRH, we controlled for this variable in our regression models and found that pre-pregnancy SRH reduced the effect of diabetes on pregnancy SRH, suggesting that pre-pregnancy SRH is a robust variable that may capture latent variables associated with diabetes in pregnancy. However, when PND and pre-pregnancy SRH were added to the diabetes models, we found that pre-pregnancy SRH did not reduce the effect of diabetes on pregnancy SRH, suggesting that these two variables make unique contributions that should be explored further. Others have found that as depressive symptoms increase during pregnancy, SRH worsens (56). However, these associations were not explored in the context of diabetes in pre-pregnancy Latinas. Future studies should use larger samples that are more specific to Latinas with similar demographic characteristics. Future studies should use larger samples that are more specific to Latinas with similar demographic characteristics.

Although this study sheds light on the relationship between PND, diabetes, and SRH, it has some limitations. First, the study had a small, homogenous sample, making the results more specific to Latinas with similar demographic characteristics. Future studies should use larger cohorts of Latinas from diverse socioeconomic backgrounds. Additionally, subsequent studies should include non-Latinas with similar demographic characteristics to this sample to determine whether cultural beliefs or perceptions are associated with feelings about diabetes in pregnancy. Subsequent studies should explore the...
mediating effects of pre-pregnancy exercise, substance use, and poverty on associations between PND, diabetes, and SRH. Additionally, this study lacked pre-pregnancy metabolic data, which prevented us from exploring whether they are associated with PND and SRH. Given previous research showing a relationship between high pre-pregnancy BMI and perinatal depression (73,74), it is likely we would have had similar results. However, this speculation should be confirmed empirically.

Because less is known about the association between pre-pregnancy BMI and SRH, future studies should include pre-pregnancy BMI to assess its effect on SRH. Finally, this study did not measure glucose control, which has been shown to be associated with depression during the non-pregnant period (75) and pregnancy (76). Therefore, further studies should include blood glucose levels from pregnant women with diabetes to assess the association between glycemic status and women's own health perceptions. Finally, subsequent investigations should include a qualitative component to further understand the challenges pregnant women with diabetes face as they relate to cultural expectations and needs to allow for more culturally sensitive care and self-management.

Clinical Implications

Given findings regarding the associations between SRH, PND, and diabetes, health care providers should assess SRH throughout the course of pregnancy in women with PND to identify women who are experiencing additional effects on self-assessments because of poor mental health. Screening for poor SRH may offer providers an opportunity to educate women at risk of depression and provide coping strategies or treatment as needed.

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TABLE 3. Results From the Ordinal Logistic Regressions With Pregnancy SRH as the Outcome and Any Diabetes as the Main Predictor (n = 34)

| Model | B (SE) | 95% CI | P    | B (SE) | 95% CI | P    | B (SE) | 95% CI | P    | B (SE) | 95% CI | P    |
|-------|--------|--------|------|--------|--------|------|--------|--------|------|--------|--------|------|
| Any diabetes | -2.167 (0.82) | -3.77 to -0.56 | 0.008 | -2.638 (0.853) | -4.31 to -0.97 | 0.002 | -1.355 (0.85) | -3.04 to 0.33 | 0.115 | -2.301 (0.95) | -4.15 to -0.45 | 0.015 |
| PND   | -2.368 (0.78) | -3.90 to -0.84 | 0.002 |        |        |      |        |        |      |        |        |      |

Pre-pregnancy SRH

- Poor
- Fair
- Good
- Very good

The reference groups were no diabetes, no PND, and excellent SRH.

TABLE 4. Results From the Ordinal Logistic Regressions With Pregnancy SRH as the Outcome and GDM as the Main Predictor (n = 34)

| Model | B (SE) | 95% CI | P    | B (SE) | 95% CI | P    | B (SE) | 95% CI | P    | B (SE) | 95% CI | P    |
|-------|--------|--------|------|--------|--------|------|--------|--------|------|--------|--------|------|
| GDM only | -2.383 (1.03) | -4.91 to -0.36 | 0.021 | -2.434 (1.03) | -4.45 to -0.41 | 0.018 | -1.825 (1.07) | -7.85 to -2.64 | 0.087 | -2.230 (1.11) | -4.41 to -0.05 | 0.045 |
| PND   | -2.016 (0.75) | -3.49 to -0.54 | 0.007 |        |        |      |        |        |      |        |        |      |

Pre-pregnancy SRH

- Poor
- Fair
- Good
- Very good

The reference groups were no diabetes, no PND, and excellent SRH.
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Duality of Interest
No potential conflicts of interest relevant to this article were reported.

Author Contributions
S.L.-C. conceptualized the project, secured funding, collected the data, led the data analysis, and supervised all aspects of the manuscript. C.S. contributed to the data analysis and introduction. D.M. assisted with the methods and results. H.H. contributed to the discussion. S.L.-C. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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