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Anxiety in pregnancy and length of gestation: Findings from the Healthy Babies Before Birth Study

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Abstract

Objectives: Anxiety is prevalent in pregnancy and predicts risk of adverse birth outcomes. Many instruments measure anxiety in pregnancy, some of which assess *pregnancy anxiety* defined as maternal concerns about a current pregnancy (e.g., baby, childbirth). The present study examined covariance among four anxiety or distress measures at two times in pregnancy and tested joint and individual effects on gestational length. We hypothesized that the common variance of the measures in each trimester would predict earlier delivery.

Methods: Research staff interviewed 196 women in first and third trimester utilizing a clinical screener of anxiety severity/impairment, two instruments measuring pregnancy anxiety, and one on prenatal distress. Birth outcomes and medical risk factors were obtained from medical records after birth. Structural equation modeling fit latent factors for each trimester from the four measures. Subsequent models tested whether the latent factors predicted gestational length, and unique effects of each measure.

Results: The third-trimester pregnancy anxiety latent factor predicted shorter gestational length adjusting for mother's age, education, parity, and obstetric risk. Scores on a four-item pregnancy-specific anxiety measure (PSAS) in third trimester added uniquely to prediction of gestational length. In first trimester, scores on the clinical screener (OASIS) uniquely predicted shorter gestational length whereas the latent factor did not.

Conclusion: These results support existing evidence indicating that pregnancy anxiety is a reliable risk factor for earlier birth. Findings point to possible screening for clinically significant anxiety symptoms in the first trimester, and pregnancy-specific anxiety thereafter to advance efforts to prevent earlier delivery.

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Keywords

Pregnancy anxiety; pregnancy-specific anxiety; gestational length; prenatal distress

Anxiety occurs during pregnancy for many women. Approximately 18% of women report clinically elevated anxiety symptoms in the first trimester, 19% in the second trimester, and 25% in the third (Dennis et al., 2017). Rates of prenatally diagnosed anxiety disorders are slightly lower, with about 15% of women meeting diagnostic criteria (Dennis et al., 2017). Research has extensively examined anxiety during pregnancy since the 1970s, (Dunkel Schetter & Ponting, 2021) especially anxiety about a current pregnancy. *Pregnancy anxiety* (also known as pregnancy-specific anxiety) is an affective state experienced by a pregnant woman involving concerns and worries about her prenatal health, her baby, labor and delivery, and/or future parenting (Bayrampour et al., 2016; Brunton et al., 2019; Dunkel Schetter & Tanner, 2012; Guardino & Dunkel Schetter, 2014; Ibrahim & Lobel, 2020).

Prenatal anxiety is linked to higher rates of adverse birth outcomes. Reviews conclude that anxiety during pregnancy robustly predicts shorter length of gestation and preterm birth (Alder et al., 2007; Ding et al., 2014; Field, 2017; Kramer et al., 2009; Rejnö et al., 2019; Staneva et al., 2015;). Trait, state, and pregnancy-specific anxiety have all been linked to shorter gestational length, although each of these has different magnitudes of risk (Bussières et al., 2015). For example, there is growing evidence that pregnancy-specific anxiety is a stronger predictor of gestational length than measures of more general state anxiety in studies of women of diverse ethnic/racial backgrounds and nationalities (Blackmore et al., 2016; Dunkel Schetter, 2011; Dunkel Schetter & Tanner, 2012; Roesch et al. 2004). Pregnancy-specific stress also predicts birth outcomes better than general stress measures (Lobel, et al., 2008) or trait-based anxiety assessments, life events, or exposure to disasters (Bussières et al., 2015). Additionally, general and pregnancy-specific anxiety have been shown to increase risk for transgenerational effects such as developmental delays (Hochstedler et al., 2020; Rogers et al., 2020), emotional reactivity (Nolvi et al., 2016), difficulties with cognitive performance (Jaekel et al., 2013), or behavior problems in offspring (Arpi & Ferrari, 2013). However, researchers rarely examine multiple measures of anxiety in pregnancy in a single study, limiting our ability to directly compare them in the prediction of outcomes.

Furthermore, we lack consensus on exactly *when* in pregnancy an expecting mother's anxiety may have the strongest effects on the timing of labor and delivery. Most of the evidence indicates that anxiety in mid-pregnancy predicts shorter gestational length (Staneva et al., 2015), though very few studies have examined effects of anxiety in the first trimester or across trimesters (Glynn et al., 2008; Hosseini et al., 2009; Pesonen et al., 2016). However, Weis and colleagues (2020) in a newer study found that increases in pregnancy-specific anxiety over the three trimesters were associated with preterm birth risk. Determining when in pregnancy any measure best predicts earlier delivery may inform risk screening and psychosocial interventions to prevent preterm birth and associated adversities.

With a prospective cohort design, the present study tested whether three scale measures of pregnancy-specific anxiety or distress and one screening tool for general anxiety symptoms/

impairment, each administered in first and third trimesters, predicted length of gestation. The use of four conceptually similar measures permitted determination of their common variance, as well as their unique effects on gestational length, beyond their shared variance. Having assessments at two time points enabled us to test when the effects of anxiety and distress were stronger. We hypothesized that there would be shared variance among the scale measures of prenatal anxiety and distress in first and third trimester of pregnancy, and that the common variance would predict length of gestation.

Methods

Transparency and Openness Statement

In this publication, we report how we determined our sample size, all data exclusions, and details for all measures included in the study. Analysis code and full study measures are provided in the supplemental materials. Data are available from authors upon request. Data were analyzed using Stata 16. The study design and hypotheses are entirely in accordance with the funded grant proposal aims and study design as funded by the National Institute for Child Health and Human Development (NICHD) of the National Institutes of Health under award number R01 HD073491.

Participants

The sample consisted of 196 pregnant women with prenatal and birth records and first and third trimester data. Women were recruited into the study from 2013 to 2018 at their prenatal appointments by research staff in prenatal practices and clinics at the two large urban medical centers, one serving mainly low-income patients in Denver (42.9%) and one in Los Angeles serving women with a range of income levels (57.1%).

Inclusion criteria were 18 years of age, a singleton pregnancy of up to 12 weeks gestation at recruitment, and English or Spanish language. Exclusion criteria were current substance abuse, HIV-positive, current smoking, or use of medications that could affect inflammatory processes (e.g., glucocorticoids). Among the 196 women, 45.4% identified as Non-Hispanic White, 36.2% as Hispanic White, 9.2% as Black or African American, and 9.7% as Asian.

Procedures

Data were collected as part of a longitudinal, prospective cohort study that examined biological, psychological, obstetric, and developmental processes in women during pregnancy and their infants through one year after birth. Participants were informed that they would complete interviews on key study concepts, provide biological samples, and that their infants would have developmental assessments. Participants were followed from first trimester through one-year postpartum with six study visits, one per trimester and three times in the year after birth. Structured interviews were conducted in clinical settings by trained research staff in each of the respective medical centers. Participants received parking validation and $25 in cash or a gift card as compensation for each visit. Following birth, medical staff abstracted prenatal, labor and delivery and neonatal data from medical charts. Study procedures were approved by the university and hospital institutional review boards at all participating academic and health institutions.

Measures

We used four standardized scale measures of anxiety, three developed for pregnancy. All were assessed in the first and third trimester interviews. Two scale measures of pregnancy-specific anxiety were designed to capture anxiety about a specific current pregnancy (Rini et al., 1999; Roesch et al., 2004). The third scale was designed to assess stress or distress in pregnancy (Lobel et al., 2008). The fourth is a widely used general anxiety-screening tool (Norman et al., 2006) that was included to assess and monitor impairment resulting from anxiety.

Pregnancy-Related Anxiety—The 10-item Pregnancy-Related Anxiety Scale (PRAS; Rini et al., 1999) assesses the extent to which women feel worried or concerned about their baby's health, their own health, labor and delivery, and parenting. Sample items include "I have a lot of fear regarding the health of my baby" and "I am concerned or worried about having a hard/difficult labor and delivery." This scale has high inter-item reliability, high convergent validity with other scales, and predictive validity in that scale scores have predicted preterm birth and length of gestation in past studies (Alderdice, Lynn, & Lobel, 2012; Guardino & Dunkel Schetter, 2014; Ramos et al., 2019). Responses ranged from *never* to *almost all of the time* on a 4-point scale. The two positively worded items were reverse-coded, and items were averaged to create a score from 1 to 4, with higher scores indicating greater pregnancy anxiety (α=.80 in first trimester or T1, α=.85 in third trimester or T3).

Pregnancy-Specific Anxiety—The Pregnancy-Specific Anxiety Scale (PSAS; Roesch et al., 2004) consists of four items and assesses feelings about being pregnant in the past week (anxious, concerned, afraid, panicky about this pregnancy). Responses ranged from *never* to *always* on a 5-point scale and scores were averaged with higher scores reflecting greater pregnancy-specific anxiety (α = .79 in both trimesters, T1 and T3). The PSAS shows high inter-item reliability, high convergent validity with other scales, and predictive validity in several studies (Alderdice, et al., 2012; Guardino & Dunkel Schetter, 2014; Mancuso, et al., 2004).

Prenatal Distress—The Revised Prenatal Distress Questionnaire (NuPDQ; Lobel, 1996) assesses stress originating from common concerns during pregnancy. This instrument has slightly different versions for administration in different trimesters. For the purposes of comparison over trimesters, we used nine core items regarding experiences that could arise any time during pregnancy (Lobel et al., 2008). Sample items are: "are you feeling bothered, upset, or worried at this point in your pregnancy about…the quality of your medical care; taking care of a newborn baby; working at a job after the baby comes." Responses ranged from *not at all* to *very much* on a 3-point scale. Items were averaged to create a total score ranging from 1 to 3 with higher scores indicating greater distress. This core 9-item version of the scale has shown predictive validity with higher values related to preterm delivery and lower birth weight (Lobel et al., 2008). This is a reliable scale though inter-item reliability can be lower compared to other scales (Lobel et al., 2008). Cronbach's alpha coefficients in the current study (α=.69 at T1, α=.65 at T3) were similar to past studies using this measure.

Anxiety Symptom Severity and Impairment—The Overall Anxiety Severity and Impairment Scale (OASIS; Norman et al., 2006) was used to screen for clinically significant levels of anxiety. The five-item OASIS assesses frequency, severity, and functional impairment of anxiety and is validated in clinical and community samples. An example item is *"In the past week, how much has anxiety interfered with your social life and relationships?"* Each item is answered on a 5-point scale with anchors for each response (0 = none/*no anxiety in the past week* to 4= extreme/*constant anxiety*. Total scores range from 0 – 20; mean scores were calculated across items with higher scores indicating greater severity and impairment from anxiety (α = .85 at T1 and T3).

Covariates—Maternal age and education (number of years completed) were assessed at study outset. Medical staff coded medical/obstetric risk factors and parity from medical charts after delivery. Parity was coded as 0 = nulliparous or 1 = multiparous. Full information on health and pregnancy history and current pregnancy complications was coded after birth from prenatal and labor and delivery records, including relevant risk conditions and complications throughout pregnancy in order to create an obstetric risk index that included 6 categories of well-established risk factors for preterm birth (Hobel, 1982): (1) any severe infection during pregnancy or previous pregnancy; (2) hypertension during pregnancy or previous pregnancy; (3) diabetes during pregnancy or previous pregnancy; (4) any vascular risk factor, such as vaginal bleeding, anemia, placenta previa, or placental abruption; (5) oligohydramnios; and (6) polyhydramnios. The total number of risk factors for each participant was summed and then scores were meancentered.

Analysis Plan

First, we examined descriptive statistics and bivariate correlations among study variables. Then, structural equation modeling (SEM) was used to determine whether the different measures of anxiety in pregnancy loaded onto one prenatal anxiety factor at first and at third trimester. Each measure of pregnancy anxiety was *z*-transformed in order to compute standardized loading of each measure on the latent factor. Complete data were available for 196 out of 233 participants recruited for the first trimester models and 181 participants in the analysis of the third trimester models. Next, SEM analyses tested whether higher levels of pregnancy anxiety on the latent factor were associated with shorter gestational length adjusting for mother's age, education, parity, and medical risk. Separate models were tested for pregnancy anxiety in first and third trimester. Per convention, models with RMSEA values less than .08, CFI values greater than .90, and SRMR values less than .08 were determined to have acceptable model fit. The path from the latent pregnancy anxiety factor to gestational age was included along with covariates. All models treated gestational age in weeks as a continuous variable given sample size and consistent with prior research (e.g. Lobel, et al., 2008). Empirical indications of model fit (i.e., modification indices) were not used to determine whether to delete any pathways because these indices can result in model misspecification and over-fitting (Chou & Huh, 2012). Therefore, all paths were retained in models.

In order to identify the best measures for prenatal screening, a series of models examined whether each of the four measures of pregnancy anxiety was uniquely related to gestational

length after accounting for the effects of the pregnancy anxiety latent factor. In separate models for each prenatal anxiety/distress measure at each trimester, a path was added from the residual of the measure (i.e., Oasis, PSAS, PRAS, NuPDQ) to length of gestation, with all covariates in the models. A significant pathway indicated a unique contribution to gestational length beyond that of the shared variance of the measures. Again, we did not use indices of model fit to trim these models, interpreting results without modifications. Another model was then tested with all pregnancy anxiety measures included simultaneously. Finally, supplemental analyses tested associations unadjusted for covariates. Models were repeated using full information maximum likelihood (FIML)estimation.

Results

Descriptive Statistics

Descriptive statistics on all study variables for the full sample appear in Table 1.

Demographics—The women in the sample were 31 years of age on average (M_{age} = 30.94 years (*SD*=5.65). The median per capita annual household income adjusted for cost of living in the two sites was $20,539 (M = $29,618.48, *SD* = $27,709.38) and maternal education was 15.72 years, (*SD* = 3.33). At study outset, about two-thirds of participants were married (67.4%), with 23.5% unmarried/cohabitating with a romantic partner, and the remainder in a partner relationship but not cohabiting (6.1%) or not partnered (3.1%).

Medical Factors—About half of the sample was pregnant with their first child (55.1%). Regarding medical risk factors, the sample was composed of slightly over one-third with no risk factors or low risk (39.3%), an equal portion of women had one potentially serious risk condition (37.8%), and nearly one-quarter had two or more risk factors (22.9%; range = 0–4; Table 1). About one quarter of the sample (24%) was obese based on their pre-pregnancy BMI (*M* = 26.17, *SD* = 6.82).

Anxiety—About 12.8% of participants scored at or above 8 on the OASIS indicating clinically significant anxiety. Autocorrelations of measures of anxiety in pregnancy were significantly correlated from first to third trimester (OASIS, $r = .41$; PSAS, $r = .48$; PRAS, $r = .62$; NuPDQ, $r = .68$, all p's < .001). At first trimester, the four measures were intercorrelated from $r = .32$ to $r = .65$ (all p's < .001), with the strongest associations between PSAS and the other three measures (Table S1). The only significant associations with gestational length at the bivariate level were OASIS in first trimester ($r[194] = -.17$, $p = .016$), and PSAS in third trimester ($r[179] = .26$, $p <. 001$).

Attrition—Fifteen participants did not complete the third trimester visit. These participants did not differ from those who did with respect to age, race, ethnicity, history of preterm birth, BMI prior to pregnancy, years of education, or anxiety and distress variables (all p's > .05). However, women who did not complete the third trimester visit had significantly shorter gestational length ($t[194] = 3.26$, $p = .001$) and significantly higher levels of first trimester pregnancy-specific anxiety on one of the four measures (PSAS, $t[194] = 2.36$, $p = .019$) relative to women who completed third trimester visits.

Model Testing

Latent Factors for First and Third Trimester—First, models tested whether the different measures of anxiety in pregnancy loaded onto one factor as hypothesized. As expected, all measures loaded onto a single latent pregnancy anxiety factor at the first and at the third trimesters with good fit for both. Figure 1 shows the coefficients for the two models (first and third trimester).

Predicting Length of Gestation with First and Third Trimester Latent Factors.—Next, models tested whether the two pregnancy anxiety latent factors predicted gestational length. The first trimester latent factor did not significantly predict length of gestation controlling for mother's education, age, previous births, and obstetric risk, $B = -0.04$, $SE = 0.19$, $p = .80$, $\beta = -.02$. However, the third trimester latent factor had a significant, moderate effect on gestational length, such that mothers with higher anxiety in pregnancy during the third trimester gave birth earlier (Fig. 2). The overall model showed good fit; $\chi^2(17) = 25.66$, $p = .08$; RMSEA =.053, CFI = .960, SRMR = .040.

Unique Contributions of Individual Measures—Finally, separate models examined whether each individual measure predicted gestational age, when accounting for the effects of the respective latent factor and covariates. During the first trimester, a unique effect of the OASIS measure on gestational length emerged, such that greater anxiety severity and impairment had a small inverse effect on gestational length, after controlling for the pregnancy anxiety latent factor and covariates; $B = -0.43$, $SE = 0.17$, $p = .011$, $\beta = -.20$. This overall model showed good fit; $\chi^2(16) = 25.68$, $p = .059$; RMSEA = .056, CFI = .96, SRMR = .040. A significant, small effect also emerged for the NuPDQ, although higher NuPDQ scores were associated with *longer* gestational age, $B = 0.50$, $SE = 0.22$, $p = .023$, $\beta = .23$ and the model showed good fit; $\chi^2(16) = 26.90$, $p = .043$; RMSEA = .059, CFI = .96, SRMR = .042. Neither the first trimester 10-item PRAS, $B = 0.37$, $SE = 0.36$, $p = .30$, $\beta = .18$, nor the 4-item PSAS, $B = -0.49$, $SE = 0.29$, $p = .094$, $\beta = -.23$ were significantly related to gestational length independent of the latent factor and covariates. Next a model examined all four first trimester measures as predictors simultaneously. Similar to when each measure was tested separately, significant unique effects emerged again for the OASIS ($B = -0.12$, $SE = 0.05$, $p = .011$, 95% CI [−0.21, −0.03], $\beta = -.20$) and the NuPDQ ($B = 1.22$, $SE = 0.54$, $p = .023$, 95% CI [0.17, 2.28], $\beta = .19$; see Figure S1).

During the third trimester of pregnancy, unique effects of the PSAS measure and the NuPDQ measure contributed to gestational length beyond the effects of the third trimester pregnancy anxiety latent factor and covariates. Higher PSAS scores were related to shorter gestational length with a medium to large effect, $B = -0.63$, $SE = 0.24$, $p = .009$, $\beta = -.40$, whereas, again, higher NuPDQ scores were related to longer gestational age with a medium effect; $B = 0.45$, $SE = 0.20$, $p = .025$, $\beta = .29$. Both models showed good fit; for PSAS, $\chi^2(16) = 19.13$, $p = .26$; RMSEA = .033, CFI = .986, SRMR = .035; and for NuPDQ, $\chi^2(16) = 20.35$, $p = .20$; RMSEA = .039, CFI = .980, SRMR = .038. Neither the OASIS, $B = 0.14$, $SE = 0.13$, $p = .30$, $\beta = .09$, nor the PRAS in third trimester, $B = -0.02$, $SE = 0.18$, $p = .92$, $\beta = .00$, significantly predicted gestational length controlling for the pregnancy anxiety latent factor and covariates. When all third trimester measures were included simultaneously, the

effect of the PSAS remained significant (B = −0.61, SE = 0.19, p = .001, 95% CI [−0.99, −0.24], β = −.31). However, the effect for the NuPDQ was no longer significant (B = 0.77, SE = 0.51, p = .132, 95% CI [−0.23, 1.78], β = .14).

To examine the robustness of results, supplemental analyses tested associations unadjusted for covariates which revealed that all significant results remained significant in these models. To account for attrition across the study, we repeated all models using full information maximum likelihood (FIML) estimation and the results were again unchanged.

Discussion

In this study, we examined multiple measures of prenatal anxiety or distress measured early and late in pregnancy. Two scales assessed pregnancy-specific anxiety (an affective state concerning the current pregnancy) which has received a great deal of attention in the literature given its consequences for physiology and birth outcomes, especially shortened length of gestation (Blackmore et al., 2016; Dunkel Schetter, 2011; Dunkel Schetter et al., in press; Field, 2017, Kane et al., 2014; Rini et al., 1999; Staneva et al., 2015). A third scale assessed pregnancy distress, or a broader set of concerns regarding a current pregnancy. The fourth scale, the OASIS, is a clinical screener used to for determining general anxiety severity and impairment.

The purpose of testing the relative effects of different measures of prenatal anxiety and distress was two-fold. First, reliable evidence indicates that anxiety specific to the pregnancy is a better predictor of length of gestation than various other concepts and measures of stress, state anxiety or depressive symptoms (Accortt et al., 2015; Dunkel-Schetter & Glynn, 2011; Dunkel Schetter & Tanner, 2012; Kramer et al., 1999). However, there are many measures of anxiety used in prenatal research, and the degree to which they overlap or differ in predictive ability has not been clarified. Few if any studies have compared these measures on multiple occasions, which was the aim of the current study. We found that the four measures loaded onto one latent factor that achieved good fit in both the first and third trimesters, indicating significant shared variance among four commonly used scale measures in the literature. The common variance appears to represent the concept of *pregnancy anxiety* that is also referred to in literature as pregnancy-related anxiety (Bayrampour et al., 2016; Brunton et al., 2019; Dunkel Schetter & Ponting, 2021). In the third trimester -- but not the first – the latent factor predicted the timing of birth with a medium effect size such that higher pregnancy anxiety in third trimester predicted shorter gestational length independent of obstetrical risk. This bolsters findings indicating that the timing of anxiety in pregnancy is important for understanding its effects on birth outcomes such as the timing of delivery (Glynn et al., 2008). As pregnancy progresses, the effects of prenatal anxiety may be more consequential.

A second goal was to test the unique effects of each measure in each trimester independent of the latent factor to identify which screening tools may be most useful for identifying women at risk for shorter gestation and possibly preterm birth. When we examined whether each of the individual measures contributed unique effects to the prediction of gestational length, we found different effects in each trimester. In the first trimester, greater anxiety symptom severity and impairment as measured by the OASIS uniquely predicted shorter

gestational length, although the latent factor did not. In the third trimester, pregnancy-specific anxiety as measured by the PSAS significantly and uniquely predicted shorter gestational length, beyond the significant contribution of the latent factor with a medium to strong effect size. The PSAS is a very brief measure that captures pregnancy-specific worries over the past week (Roesch et al., 2004) and factor loadings indicated that it accounted for the largest amount of shared variance in the latent prenatal anxiety factor. Notably, in a large epidemiological study that followed over 5,000 mothers in Montreal, Canada (Kramer et al., 2009), the PSAS was the only one of many psychosocial variables (e.g., job-related stress, negative life events, relationship strain) measured at 24–28 weeks gestation that predicted preterm birth controlling for medical and obstetric risk, smoking, maternal age, perception of medical risk, depression, and nulliparity. The authors state: "Among the large number of stress and distress measures studied, only pregnancy-related anxiety was consistently and independently associated with spontaneous preterm birth (for values above the median, adjusted odds ratio ¼ 1.8 (95% confidence interval: 1.3, 2.4)), with a dose-response relation across quartiles." In another study of 282 pregnant women in the western United States, pregnancy anxiety assessed with the PSAS in the third trimester also significantly predicted gestational length independent of key covariates, namely medical risk, income, education, and parity (Mancuso et al., 2004). Thus, convergent evidence indicates that assessment of pregnancy anxiety with the PSAS in second and third trimesters predicts gestational length in well controlled studies in two western countries.

That the pregnancy distress measure (NuPDQ) showed a significant and opposite effect on gestational length after accounting for the shared variance among the four measures in both first and third trimesters was unexpected. Some theoretical models on the effects of stress on birth and child outcomes suggest curvilinear effects such that moderate levels of stress (and distress) are optimal (Mahrer et al., 2020; Staneva et al., 2017), which may explain this effect. Nonetheless, the latent prenatal anxiety factor had the strongest effect on length of gestation in line with prior studies identifying anxiety as a more consistent predictor of gestational length compared to measures of stress or distress (Dunkel Schetter & Tanner, 2012). Furthermore, bivariate correlations indicated that there was no association between NuPDQ scores and gestational age, and the positive association only emerged when including the variance shared across measures.

These results further suggest that pregnancy anxiety is a more potent risk factor for earlier delivery when elevated late in pregnancy as compared to early in pregnancy. This may be because pregnancy anxiety increases over pregnancy (van der Zwan, et al., 2017). However, we also found that greater first trimester *general anxiety* symptom severity and impairment (OASIS) contributed risk for earlier delivery. Of interest, some prior work points to both the first and third trimesters as consequential in regard to the prevalence and severity of prenatal anxiety (Lee et al., 2007). One possibility is that *general anxiety* early in pregnancy predisposes women to be anxious later in pregnancy about such issues as medical risks, the baby, labor and delivery, and/or parenting. Consistent with this argument, and our findings, trait anxiety in early pregnancy predicted later pregnancy-specific anxiety in a prior study (Huizink et al., 2014). Although not all women who begin pregnancy with general anxiety symptoms will later experience pregnancy-specific anxiety, our results suggest that women who do follow this progression are likely to be especially at risk for earlier delivery. Of

note, the study design did not include all four instruments in second trimester precluding evaluation of mid-pregnancy effects.

The role of obstetrical risk in prediction of risk deserves note. In the present study, the bivariate associations of risk factors compiled from medical charts following delivery with length of gestation were not significant with one exception. Of the four measures at two time points, the only predictor significantly associated with obstetrical risk was the PSAS in first trimester (see Supplemental Information). However, the obstetrical risk score was significantly inversely associated with birthweight. Past research on psychosocial risks for adverse birth outcomes has usually, though not always, controlled for obstetrical risk using published comprehensive risk indicators such as that used here, and research consistently finds that prenatal anxiety independently predicts adverse birth outcomes. Elsewhere, we suggest that prenatal anxiety is a stronger independent predictor of gestational length whereas other psychosocial factors such as chronic stress and depressive symptoms independently predict birthweight (Dunkel Schetter & Tanner, 2012). Nonetheless, the present findings and those in the literature strongly suggest that obstetrical risk is not underlying the phenomenon of prenatal anxiety, although it is a contributor along with many other conditions in pregnant women's lives (Dunkel Schetter, 2011).

The present study adds to growing evidence supporting the potential utility of screening for anxiety in prenatal clinical settings as is commonly done for depressive symptoms (Dagher et al., 2021). Furthermore, these results point to which screening tools that may be most useful at particular times during pregnancy. Given that it is typically not feasible to administer a whole battery of risk assessments repeatedly in pregnancy, it may be most useful to administer the OASIS screener in first trimester to detect women who are at risk for severe or impairing anxiety and possible anxious dispositions or disorders. Women scoring high on this screener can be monitored during pregnancy for changes in their anxiety or comorbid symptoms. With respect to screening later in pregnancy, best practice may be to use the briefest measure, the PSAS although it does not capture the sources of a woman's anxiety. For that purpose, follow-up assessment with slightly lengthier measures that help to identify sources of anxiety (i.e., NuPDQ) may be best to inform targeted intervention efforts. This screener identifies the sources of anxiety may be best to inform targeted intervention.

For the reduction of pregnancy anxiety, assessment-driven prenatal care education may be a feasible and practical avenue as compared to other efficacious mental health interventions To the extent that medical risk conditions increase anxiety in pregnancy and adverse birth outcomes, a conservative approach would be to provide prenatal education for women high in medical risk and pregnancy anxiety. Evidence-based psychotherapies such as cognitive behavioral therapy or mindfulness training for prenatal anxiety (Akgün, Boz & Ozer, 2019) usually last several months and require weekly attendance which may be quite burdensome in pregnancy (Gennaro et al., 2020). Given that pregnant women often discontinue mental health treatment during pregnancy, any interventions should be relatively brief if possible (Kornfield et al., 2017). In sum, the relative efficacy of screening and subsequently intervening with efficacious and acceptable treatments should be a research priority (Accortt & Wong, 2017).

The strengths of this study include recruitment of a sample from more than one geographic region with a high percentage of Latinas, some variability in socioeconomic status and medical risk, and an interview methodology designed to be culturally sensitive with trained bilingual staff. We also had good retention and there were no effects on findings in supplemental models. In terms of limitations, sample size restricted testing categorical outcomes (e.g., preterm vs term birth) or moderation by ethnicity. Further, we did not test whether women with a history of anxiety were at risk for shorter gestational length. In addition, the study design did not include all four instruments in second trimester precluding evaluation of mid-pregnancy effects, nor did we have the longer and later published version of the NuPDQ (Ibrahim & Lobel, 2020). Although our sample varied in risk factors, additional studies on high risk women with careful attention to medical risk as it influences anxiety concerning pregnancy is merited.

In future, study designs with repeated measures of pregnancy anxiety in the first two trimesters can model changes in this affective state as a result of the emergence of new medical risk conditions. Ideally, researchers will also examine how risk conditions are communicated to women, and, importantly, if women understand what they are told and how they respond over time affectively and behaviorally. These more granular longitudinal analyses can clarify if, and to what extent, medical risk change women's levels of anxiety in pregnancy. We know that women often do not understand communications about their risk conditions especially if there are education, language or cognitive barriers, and that many women cope with risk by avoidance or other healthy or unhealthy ways of coping to make risks less distressing (Lobel, et al. 2008). The fast pace of prenatal care visits contributes further to an imprecise connection between risk factors and women understanding their meaning and significance.

Conclusions

By measuring pregnancy-specific anxiety, severity and impairment of anxiety symptoms, and pregnancy distress on two occasions in pregnancy (early and late) with a set of four published reliable and valid measures and, by use of structural equation modeling, this study builds on existing research in several important ways. Specifically, it further substantiates that the central concept, *pregnancy anxiety*, if present in third trimester contributes to shorter length of gestation but possibly not as early as first trimester. Furthermore, two instruments (OASIS, PSAS) emerged as predictors of shorter gestational length after accounting for the pregnancy anxiety latent factor, and these two instruments may be useful in clinic settings for screening in first trimester (OASIS) and repeatedly thereafter (PSAS). Beyond these findings, this study strongly supports further research on prenatal anxiety screening. Increasing precision in our understanding of both the risks and mechanisms of the effects of pregnancy anxiety on gestational length can improve our ability to develop, test, and implement interventions to address the pressing public health issue of preterm birth.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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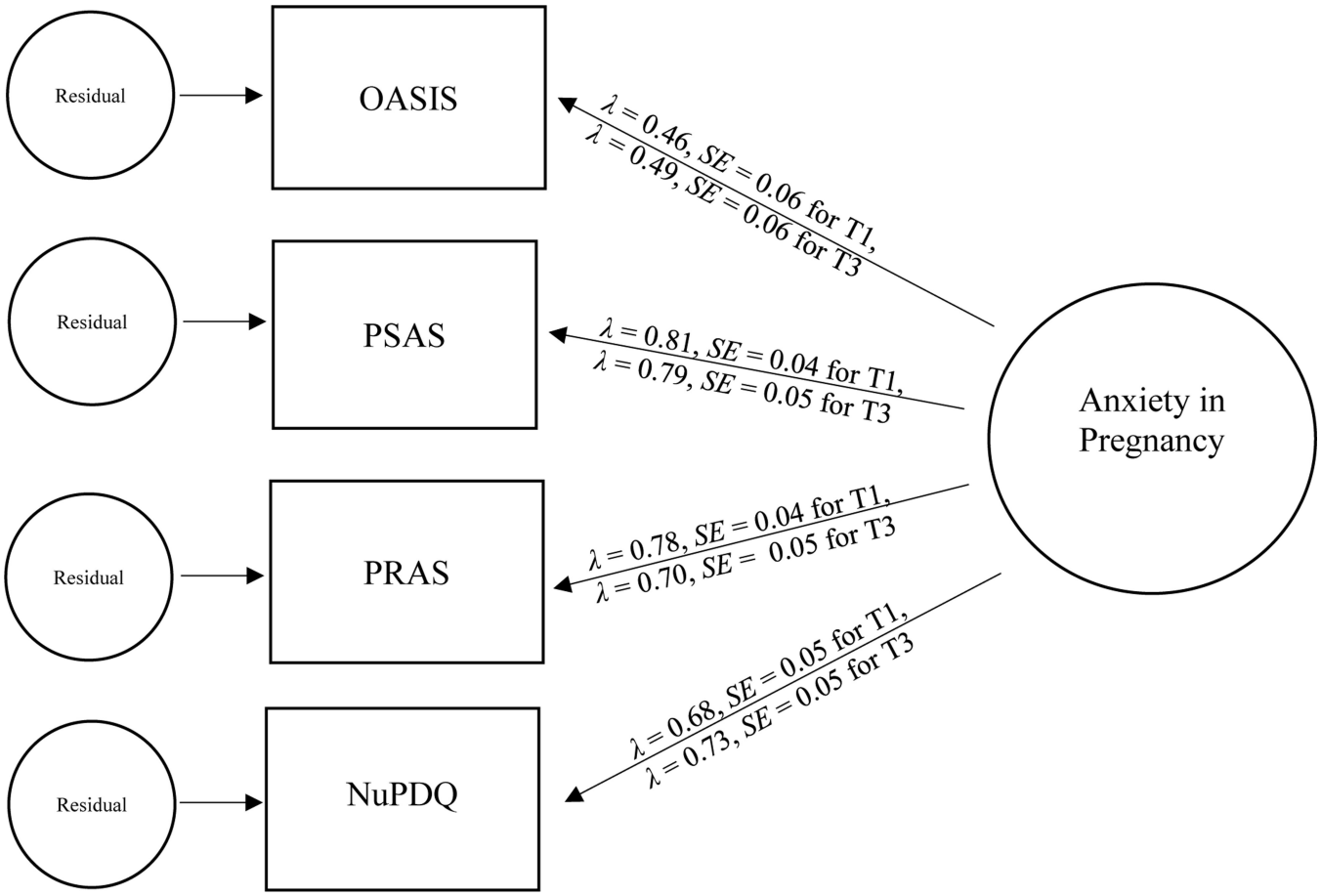

Figure 1.

Structural equation model testing single latent factor of pregnancy anxiety

Notes: Path coefficients for the first trimester are presented above the arrow and path coefficients for the third trimester are presented below the arrow. Models showed good fit; $\chi^2(2) = 3.478$, $p = .18$, RMSEA = .056, CFI = .994, SRMR = .020 for first trimester; $\chi^2(2) = 2.663$, $p = .26$, RMSEA = .041, CFI = .997, SRMR = .021 for third trimester; all paths ps < .001 for individual factor loadings across all trimesters. Predictor variables were z-standardized and the variance of the latent factor was constrained to 1 for ease of interpretation of coefficients. Models did not suggest any empirically derived modification indices. OASIS = Overall Anxiety Severity and Impairment Scale, PSAS = Pregnancy-Specific Anxiety Scale, PRAS = Pregnancy-Related Anxiety Scale, NuPDQ = Revised Prenatal Distress Questionnaire, T1= first trimester, T3= third trimester. Factor loadings are presented using λ.

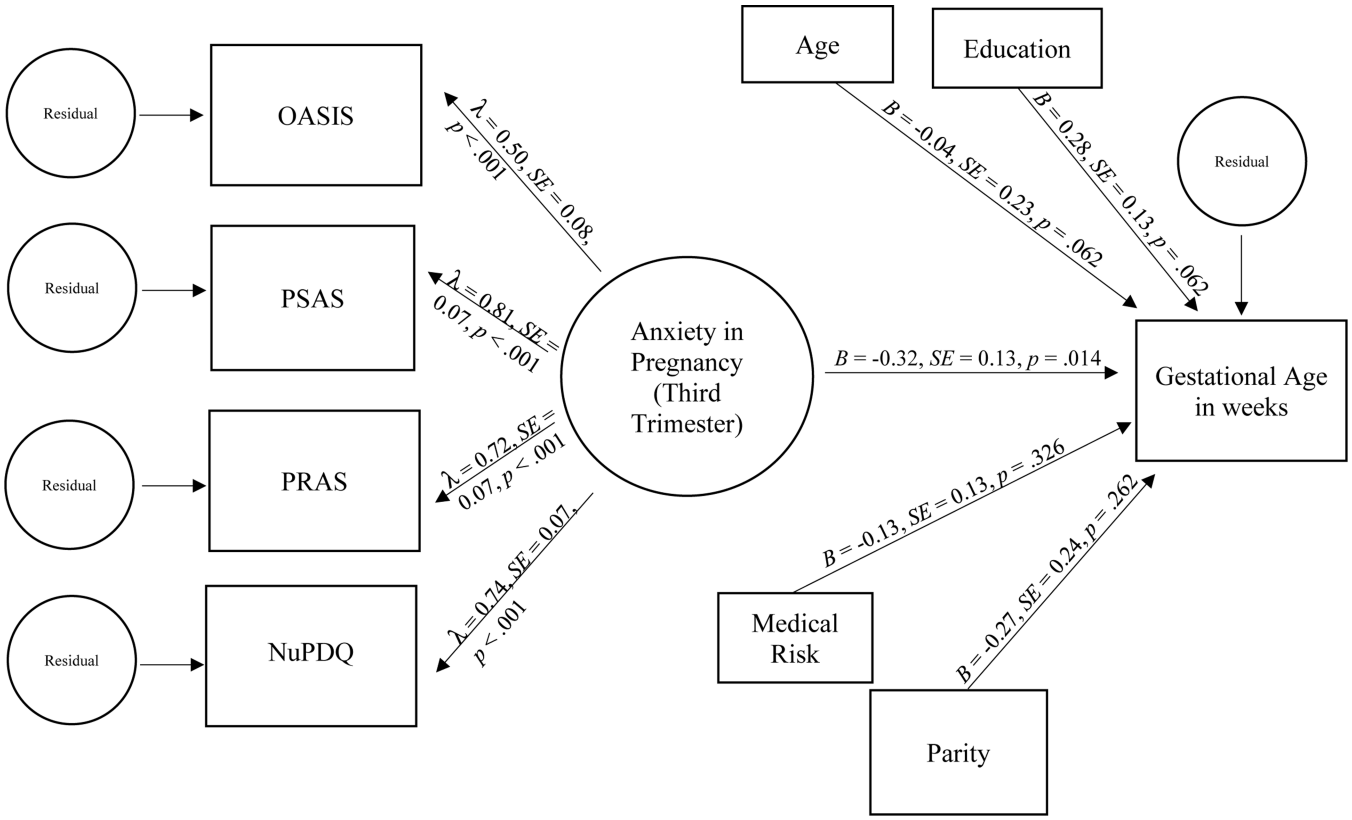

Figure 2.

Structural equation model testing the latent factor of anxiety in pregnancy and gestational age

Note: Mother's age, education parity, and medical risk were included as control variables. Models showed good fit; $\chi^2(17) = 25.66$, $p = .08$; RMSEA = .053, CFI = .960, SRMR = .040 for the third trimester, OASIS = Overall Anxiety Severity and Impairment Scale; PSAS = Pregnancy-Specific Anxiety Scale; PRAS = Pregnancy-Related Anxiety Scale; NuPDQ = Revised Prenatal Distress Questionnaire. Parity was coded as 0 = nulliparous or 1 = multiparous. Factor loadings are presented using λ.

Table 1.

Descriptive statistics for study variables

Variable	*N*	*M* (*SD*)/%
Age	196	30.94 (5.65)
Years of Education	196	15.72 (3.33)
4-Year College Degree	106	54.08%
Maternal Years of Education [a]	171	13.47 (4.18)
Paternal Years of Education [a]	151	13.90 (4.58)
Income per Capita [b]	183	29618.48 (27709.38)
Medical/Obstetric Risk [c]	196	60.71%
Ethnicity		
Non-Hispanic White	89	45.40%
Hispanic White	71	36.22%
Black or African American	18	9.18%
Asian	19	9.69%
Multiparous	88	44.90%
Gestational Age	196	38.91 (2.08)
1st Trimester	196	
OASIS	196	0.64 (0.68)
PSAS	196	2.21(0.87)
PRAS	196	1.76 (0.51)
NuPDQ	196	1.47 (0.33)
3rd Trimester OASIS	182	0.75 (0.69)
PSAS	181	1.96 (0.81)
PRAS	181	1.94 (0.38)
NuPDQ	181	1.41 (0.29)
Birthweight	194	3342.58 (538.25)

Note: OASIS = Overall Anxiety Severity and Impairment Scale, PSAS = Pregnancy-Specific Anxiety Scale, PRAS = Pregnancy-Related Anxiety Scale, NuPDQ = Revised Prenatal Distress Questionnaire.

[a]Maternal and paternal years of education refer to the number of years of education completed by the mothers and fathers of participants (i.e., women who were pregnant as the time of the study).

[b]Income per capita values were adjusted for Cost of Living Index for each site (i.e., income per capita was divided by 1.42 for participants in LA and by 1.22 for participants in Denver to account for how the cost of living is 42% and 22% higher relative to the national average at each site, respectively).

[c]Medical/obstetric risk was measured as the percentage of women who reported experience one or more from a variety of conditions including severe infections, preeclampsia or hypertension and/or diabetes during current or previous pregnancies; vascular risk factors including anemia, placenta previa or abruption; vaginal bleeding; and oligohydramnios, and polyhydramnios coded by medical staff coded from medical charts after delivery.