Pregnancy-specific anxiety: which women are highest and what are the alcohol-related risks?

Joanna J. Arch*

Department of Psychology and Neuroscience, University of Colorado Boulder, 345 UCB Muenzinger, Boulder, CO 80309-0345, USA

Abstract

In a national US sample of pregnant women ($n=311$), we investigated the question of who becomes highly anxious about pregnancy by examining putative sociodemographic, pregnancy- and mental health-related predictors of pregnancy anxiety. We also assessed the contribution of pregnancy anxiety to the risk of significant alcohol consumption during pregnancy. English-speaking pregnant women aged 18+years were recruited online. Results indicated that sociodemographic factors (younger age, white, unmarried, lower education, lower household income, no previous children), feelings about current pregnancy (unwanted), and general anxiety (higher general and state anxiety) predicted higher pregnancy-related anxiety, whereas age, religiosity, number of weeks pregnant, unplanned pregnancy, and maternal depressive symptoms did not. Pregnancy anxiety was the single strongest predictor of alcohol drinking risk during pregnancy ($p<.001$, $\Delta R^2=.10$) a relationship that held after controlling for other significant predictors. Pregnancy anxiety also represented the strongest predictor of screening positively for drinking risk during pregnancy at the total T-ACE (an alcohol risk screener for pregnancy) level of 3+ (odds ratio 95% CI=1.61–4.14, $p<.001$), though not at the level of 2+ (odds ratio 95% CI=0.98–1.68, $p=.07$). We discuss implications for the link between maternal mental health and birth/ child outcomes.
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1. Introduction

The vast majority of women will be pregnant at least once in their lives (see Ventura et al. [64]). Women's mental health during pregnancy has broad and enduring consequences for both women and their children. A growing body of work demonstrates that elevated anxiety during pregnancy specifically predicts negative mental health outcomes for women [25,51] and children [2,45,46,61-63]. The roots of negative outcomes for children linked to anxiety during pregnancy likely begin in utero [30,53] and function independently of maternal depression levels [44].

Most studies linking antenatal anxiety to negative birth and child outcomes are based on maternal state and trait anxiety during pregnancy. Careful analyses by Dunkel-Schetter and others [18,31,37,40,47,52], however, have shown that a specific type of anxiety known as "pregnancy anxiety" (e.g., "pregnancy-specific anxiety") more robustly

predicts negative outcomes such as pre-term birth than does general anxiety or depression or a composite of both. Additional fetal and child outcomes linked specifically to pregnancy anxiety include higher fetal motor activity in the second to third trimesters [17], poorer infant attention regulation at 3 months [27], lower mental and motor developmental scores at 8 months [29], higher levels of restless/disruptive temperament and greater attention regulation problems at 27 months [22] and decreased gray matter density at 6 to 9 years [7].

Pregnancy anxiety has been conceptualized and measured with a variety of approaches [16,18,28,36] ranging from to hassles and uplifts associated with pregnancy [16] to fears and worries about the pregnancy itself [28] to anxiety-related feelings about being pregnant [21]. One model by Huizink and colleagues [28] suggests that pregnancy anxiety is most robustly accounted for by fear of giving birth, fear of bearing a handicapped child, and concerns about pregnancy-related changes in one's appearance. These dimensions of pregnancy anxiety, which are assessed with the Pregnancy Related Anxiety Questionnaire–Revised (2004), reflect only minor contributions from state and trait anxiety and depression and

* Tel.: +1 303 492 4634.
E-mail address: Joanna.Arch@Colorado.edu.

therefore, capture relatively unique constructs. This work, among others, suggest that pregnancy anxiety is largely distinct from more general anxiety and depression symptoms during pregnancy and uniquely predictive of pre-term birth and possibly other risky outcomes (see Dunkel-Schetter [18]).

Despite notable efforts to demonstrate the construct validity of pregnancy anxiety and its enduring consequences for offspring, relatively little is known about who is at greatest risk for elevated pregnancy anxiety or whether this form of anxiety places women at risk for negative health behaviors that may harm the fetus. With regard to *who* is at greatest risk, a study by Gurung and colleagues [21] examined a range of psychosocial predictors for pregnancy anxiety. They found that in early pregnancy (18–20 weeks), the most significant predictors of pregnancy anxiety included a (lack of) sense of mastery, life events, and attitude toward pregnancy, which together accounted for 14% of the variance in pregnancy anxiety. Demographic and medical factors accounted for only 4% of the variance. In late pregnancy (30–34 weeks), the most robust predictor of pregnancy anxiety was earlier levels of pregnancy anxiety, which accounted for nearly all of the variance in the model. Their findings suggest that attitudes toward pregnancy account for a moderate amount of variance in pregnancy anxiety and that predictors of pregnancy anxiety are largely invariant across pregnancy stages. Though this study has considerable strengths, the measure of pregnancy anxiety was not specific to particular domains of concern and consisted of only four items, with relatively low internal consistency (α's of .67−.72).

In the current study, we aimed to examine potential predictors of pregnancy anxiety that have not been well integrated in previous studies—sociodemographic, pregnancy-specific, and mental health-related. We aimed to determine the degree to which these putative predictors accounted for overall pregnancy anxiety as well as the content-specific dimensions of pregnancy anxiety outlined by Huizink et al. [28]. We also aimed to begin addressing "how" or "why" pregnancy anxiety predicts negative birth and child outcomes by examining links with risky antenatal health behaviors. Whereas previous work focused on region-specific United States or European samples, we aimed to recruit a national (United States) sample.

To begin investigating links between pregnancy anxiety and risky health behaviors, we examined whether pregnancy anxiety predicted risk for significant alcohol use during pregnancy. Other potential mediators of the association between pregnancy anxiety and negative child outcomes include HPA-axis dysfunction linked to high maternal stress and anxiety [18,62], and anxiety-linked changes in uterine blood flow [57]. Although research has yet to consistently confirm these biological mechanisms, particularly for uterine blood flow (see Kinsella et al. [30]), significant associations between maternal plasma and amniotic cortisol levels have been found (see Sarkar et al.

[53]). In addition to these potential stress-related biological mechanisms, it is possible that antenatal anxiety is associated with risky health behaviors such as alcohol consumption. Several extant findings are consistent with this possibility. Elevated maternal anxiety, including trait anxiety and panic disorder, has been implicated in greater alcohol use during pregnancy [42]. The tension reduction hypothesis [12] proposes that alcohol-induced reductions in anxiety reinforce drinking. This influential theory has met with some support [20,65] and predicts greater alcohol consumption for individuals endorsing higher levels of anxiety. Pregnancy anxiety specifically, however, has rarely if ever been examined with regard to alcohol use risk. That is, previous studies have investigated the link between pregnancy anxiety and birth/child outcomes, but have rarely if ever examined whether pregnancy anxiety associates with risky alcohol consumption *during* pregnancy. If we were to find that pregnancy anxiety predicted alcohol risk during pregnancy, this would likely help to explain the poor birth and child outcomes associated with pregnancy anxiety. Decades of research have documented devastating outcomes such as fetal alcohol syndrome stemming from heavy alcohol use during pregnancy (e.g., Refs. [3,24]). Even low levels of alcohol use during pregnancy have been linked to growth deficits and long-term detrimental behavioral outcomes [14,55], leading many experts to conclude that "no level of alcohol consumption is known to be safe in pregnancy" [43, p. 376]. In conclusion, risky alcohol use represents a potential mediator of the relationship between pregnancy anxiety and negative birth and child outcomes. This study signifies an initial step in investigating whether an association exists between pregnancy anxiety and risky alcohol use.

Due to the limited number of previous studies in this area, we did not make specific predictions regarding sociodemographic, pregnancy-specific, and mental health-related predictors of pregnancy anxiety. Based on previous research associating anxiety with increased alcohol use, and multiple negative birth/child outcomes specifically with pregnancy anxiety, we predicted that pregnancy anxiety would be associated with greater likelihood of risky alcohol use during pregnancy independent of all other putative predictors (including depression, other forms of anxiety, pregnancy-related and sociodemographic factors).

2. Methods

2.1. Participants

Four hundred forty-seven English-speaking pregnant women 18 years and older ($N=447$) were initially recruited for the study. Of these, 428 women ($n=428$) met the inclusion criteria and consented to completing the survey, and 377 women completed the full survey. Of the survey completers, we lost data on 66 due to an administrative

error[1] and therefore, our final sample consisted of $n=311$ pregnant women.

To access a national US sample, the survey and data collection took place online through Qualtrics (licensed through the University of Colorado) between April and December of 2011. Participants were recruited by posting links to the survey on national and regional pregnancy-related Web sites and listserves and the crowdsourcing Internet site Mechanical Turk. To access the study, which was entitled "Pregnancy and Mental Health Survey," potential participants had to indicate that they were female, currently pregnant, and at least 18 years old (e.g., met the study inclusion criteria). A large body of research shows that responses to online surveys generally do not differ from paper-and-pencil formats and do not alter questionnaires' reliability or underlying factor structures (e.g., Refs. [15,32,49]). Further, participants recruited from crowdsourcing Internet sites yield reliable data, to the same extent or more so than mailed paper and pencil surveys [4].

Participants reported a mean age of 27.47 years (5.97 SD; range=18–47 years) and 2 years of college education; 76.8% (239/311) identified as White/Caucasian, 6.4% (20/311) as Hispanic/Latina, 5.8% (18/311) as Asian, Asian American or Pacific Islander, 5.8% (18/311) as Black/African American, 3.5% (11/311) as Biracial, 1.3% (4/311) as Native American, and .3% (1/311) as Other. Median household income was $31,000–40,000, with 19.2% reporting a household income of $20,000 or less, and 6.1% reporting a household income of $101,000 or more. The sample represented a broad geographic range of the United States, with 25.6% (75/293) of participants living in the Northeast, 23.5% (69/293) in the Southeast, 20.1% (59/293) in the Midwest, 19.8% (58/293) in the Southwest (including California), 9.9% (29/293) in the Northwest, and 1.0% (3/293) in Hawaii.[2]

Regarding current relationship status, 57.2% (178/311) were married, 35.7% (111/311) were in an ongoing, committed relationship but unmarried, 4.5% (14/311) were single, 1.3% (4/311) were engaged to be married, 0.6% (2/311) were casually dating without commitment, and 0.6% (2/311) indicated that they were divorced/separated (from their most recent relationship partner). Participants were a mean of 24.30 weeks (SD=9.04; range=4–41 weeks) pregnant when they took the survey and 36.3% (113/311) had given birth to previous live children. Only 54.7% (170/311) of participants reported that their pregnancy was "planned" but 79.7% (248/311) indicated that they "wanted/desired" their current pregnancy after they became pregnant.

Participants accessing the survey through pregnancy Web sites and listserves were not paid for their participation, whereas those accessing the survey through Mechanical Turk were paid 50 cents for survey completion, which took 12 min or less to complete for most participants. Mechanical Turk participants were paid because the Web site provides a straightforward method of payment via PayPal. Because no straightforward method to pay participants who accessed the survey outside of Mechanical Turk was available, we did not pay these participants. Paid and unpaid participants, however, did not evidence differences on the main outcome variables (p's≥.1), likely due to the minimal payment amount.

The study was approved by the University of Colorado, Boulder, human subjects protection committee. Informed consent was obtained online from all participants.

2.2. Measures

We aimed to assess central constructs as efficiently in order to minimize the time burden for participants. We therefore selected measures that were psychometrically sound yet as brief as possible, widely used in previous studies, and appropriate for use during pregnancy. They included:

The *Patient Health Questionnaire for Depression and Anxiety* (PHQ-4) [33] was designed to screen for depression and anxiety in primary care, with related versions validated in pregnant samples (see Kroenke et al. [34]). The PHQ-4 consists of two 2-item scales, one each for depression and anxiety. The anxiety scale at a cutoff of 3 or more showed fair sensitivity (0.65 for any anxiety disorder, ranging from 0.86 for generalized anxiety disorder to 0.59 for posttraumatic stress disorder) and good specificity (0.88 for any anxiety disorder, ranging from 0.81 to 0.83 for individual anxiety disorders) across four common anxiety disorders [35], relative to Structured Clinical Interview (SCID) for DSM-IV–derived diagnoses. The anxiety scale, therefore, somewhat underdetected anxiety disorders but generally performed well. Compared to SCID for DSM-IV diagnoses, depression scale scores of 3 or above demonstrated good sensitivity of 87% and specificity of 78% for major depressive disorder and good sensitivity of 79% and specificity of 86% for any depressive disorder [38]. In the current sample, $\alpha=.86$ for the anxiety scale and $\alpha=.82$ for the depression scale.

The 10-item *Pregnancy-Related Anxiety Questionnaire-Revised* (PRAQ-R) [28] assesses three subscales of anxiety that are specific to pregnancy: fear of giving birth, fear of bearing a handicapped child, and pregnancy-related concerns about one's appearance. In the current sample, all three subscales were highly correlated with the full PRAQ-R (r's≥0.7) and the full PRAQ-R evidenced good internal consistency of $\alpha=.83$. Therefore, we first employed the full PRAQ-R in the models. If the PRAQ-R was significant at the level of $p<.09$ (see below), we followed up by examining the individual subscales. Subscales evidenced reasonable to good internal consistency, with fear of giving birth subscale $\alpha=.76$, fear of bearing a handicapped child

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[1] While revising our survey to use the PRAQ-R instead of the original PRAQ (see "Measures") to make the survey shorter and less burdensome for participants, we lost PRAQ data on a group of 66 participants due to Qualtrics error.

[2] Note that 18 participants did not indicate a geographic region.

subscale $\alpha = .89$, and concerns about appearance subscale $\alpha = .84$.

The *State-Trait Anxiety Inventory* (STAI) [56] assesses state anxiety, that is, the degree of anxiety experienced "right now… at this moment." To reduce participant burden, we used a six-item version of the STAI [41] validated on 288 parents of newborns [58]. In the parent sample, the six-item STAI demonstrated good internal consistency ($\alpha = .81$) and high correlations ($r = 0.95$) with the original 20-item STAI. In the current sample, $\alpha = .87$.

The 4-item *T-ACE* [54] screens specifically for prenatal alcohol use and has been shown to be more effective than several other alcohol screening tools in screening for risk drinking during pregnancy (defined as consuming 1 oz or more of alcohol per day during pregnancy) [6,9]. Of pregnant women screening positively on the T-ACE (total score of 2 or more), 40% met lifetime DSM-III-R alcohol use disorder diagnoses and 43% currently consumed alcohol (relative to 14% and 13% of women, respectively, who screened negatively) [10], with another study demonstrating a sensitivity of 87.8% and 89.2% for these outcomes, respectively [9]. More recent work demonstrated that increasing the T-ACE screening cutoff during pregnancy from 2 to 3 greatly improved specificity with little loss in sensitivity, and identified more neurobehavioral deficits in offspring [11]. In the current study, therefore, we investigated the T-ACE at the original cutoff of 2 as well as the potentially improved cutoff of 3 (total).

In addition to standardized questionnaires, we employed a study-specific *Demographics and Pregnancy* questionnaire that inquired about basic sociodemographics and pregnancy-related questions including pregnancy due date and whether the current pregnancy was desired/wanted or planned.

2.3. Statistical analyses

Raw data were inspected graphically; prior to data analysis, outliers (≥ 3 SD) were replaced with the next highest, non-outlier value following the Winsor method [23]. Less than 5% of the data were modified during outlier correction.

In SPSS 19.0, we constructed linear regression models to analyze continuous outcomes and logistic regression models to analyze dichotomous outcomes. To control for different scales of measurement, all continuous dependent variables were converted into *z*-scored variables prior to entry into regression models.

To assess predictors of alcohol drinking risk during pregnancy, we first separately tested models of socio-demographic and pregnancy-related predictors (model 1) and psychological predictors (model 2). Model 1 predictors included age, income, education, religiosity, race / ethnicity (self-identified as non-Latina white [0] versus non-white, Latina, or multi-racial [1]), number of weeks pregnant (at

time of study), marital status (stable unmarried relationship [0][3] versus married [1]), parity (defined herein as the number of previous *live* births, no previous live births coded 0, one or more coded 1), and whether the current pregnancy was wanted or planned (coded 1, unwanted/unplanned coded 0). Model 2 predictors included state anxiety, depression, general anxiety, and pregnancy-related anxiety. If pregnancy-related anxiety was significant or approach significance, we followed up by examining which subscales of pregnant-related anxiety contributed to this effect. Potentially significant predictors from models 1 and 2 (at the level of $p < .09$) were tested in the final model. [4] In testing the final model, non-significant predictors ($p > .05$) were removed. Further, we employed hierarchical linear regression to investigate the ΔR^2 for each predictor entered on the first versus last step of the equation. We constructed two sets of models; one assessed T-ACE as a continuous variable in linear regression and the other assessed T-ACE as a dichotomous screener in logistic regression.

To assess the predictors of pregnancy-related anxiety, we used the same model building approach except that pregnancy-related anxiety served as the dependent variable rather than a predictor. The PRAQ-R subscales in the current study correlated highly with one another (r's > 0.7) and have been employed as a single scale [27] and yet also have been shown to assess different dimensions of pregnancy anxiety [28]. Therefore, we constructed one model that examined the predictors of overall pregnancy anxiety (PRAQ-R total) and a second set of models that examined the predictors of each pregnancy anxiety subscale.

3. Results

The means and standard deviations for the psychological and outcome variables are displayed in Table 1.

3.1. What predicted overall pregnancy-related anxiety?

The predictors of overall pregnancy-related anxiety (PRAQ-R total) are displayed in Table 2a. Significant predictors in the final model included education, parity, state

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[3] We chose to contrast married versus stable but unmarried relationship status because these represented the largest categories of relationship status ($n = 289$); relatively few women reported other types of relationships or lack thereof ($n = 22$). Models in which marital status was significant, therefore, excluded the minority of women who had other types of relationships (e.g., total $n = 289$). To maximize sample size and corresponding statistical power, models in which marital status was non-significant (and therefore omitted) included the 22 non-partnered women (e.g., total $n = 311$). However, identical results were found when these non-partnered women were excluded (e.g., total $n = 289$).

[4] In the preliminary models, we assessed potentially significant predictors (for testing in the final model) at the level of $p < .09$ because due to the many demographic variables in the preliminary models, some of which were moderately correlated, predictors may have been somewhat reduced in terms of statistical significance. For the final models, we kept such variables only if they reached the $p \leq .05$ significance level.

Table 1
Means and standard deviations for psychological study variables.

	M or %	SD or portion
State anxiety	14.90	3.96
General anxiety	7.42	3.86
Depression	6.10	3.84
Overall pregnancy anxiety	29.32	7.84
Fear of giving birth subscale	9.26	3.23
Fear of bearing a handicapped child subscale	11.21	4.13
Concerns about one's appearance subscale	8.85	3.26
T-ACE continuous	1.10	1.33
T-ACE score of 2+	40.51%	126/311
T-ACE score of 3+	12.54%	39/311

anxiety, and general anxiety; together they accounted for 41% of the variance in pregnancy anxiety. Higher education and having birthed previous children predicted lower overall pregnancy anxiety whereas higher state and general anxiety predicted higher pregnancy anxiety.

3.2. What predicted fear of giving birth?

For the fear of giving birth scale of the PRAQ-R, significant predictors in model 1 (sociodemographic and pregnancy-related predictors) included income ($b=-0.49$,

Table 2a
Sociodemographic, pregnancy-related and psychological predictors of overall pregnancy anxiety (PRAQ-R total).

	b	SE	*t*	*p*	
Model 1 predictors, model adjusted $R^2=.20$					
Age	−0.31	0.51	−0.60	.55	
Income	−0.67	0.54	−1.25	.21	
Education	−0.89	0.51	−1.74	.08	
Religiosity	−0.15	0.44	−0.34	.74	
Race/ethnicity	−1.67	1.03	−1.63	.11	
Parity	−4.88	0.96	−5.09	<.001***	
Marital Status	−1.28	1.01	−1.27	.21	
Pregnancy Wanted	−2.59	1.33	−1.95	.05	
Pregnancy Planned	−0.31	1.05	−0.30	.77	
Weeks pregnant	0.13	0.42	0.32	.75	
Model 2 predictors, model adjusted $R^2=.31$					
State anxiety (STAI)	2.33	0.43	5.42	<.001***	
Depression (PHQ-4)	0.54	0.47	1.17	.25	
General anxiety (PHQ-4)	2.19	0.49	4.44	<.001***	
Final combined model, model adjusted $R^2=.41^a$ (n=311)					*ΔR² if entered on first /last step*
Education	−1.04	0.35	−2.95	.003**	.05/.02
Parity	−4.61	.72	−6.39	<.001***	.12/.08
State anxiety (STAI)	2.20	0.41	5.31	<.001***	.25/.05
General anxiety (PHQ-4)	2.17	0.43	5.10	<.001***	.26/.05

** *p*<.01
*** *p*<.001
[a] Pregnancy wanted was no longer significant in the combined final model, *p*=.11, and thus was omitted.

SE=0.19, $t=-2.58$, $p=.01$), and parity ($b=-4.06$, SE=0.34, $t=-12.01$, $p<.001$) such that higher income and having previous children predicted lower fear of giving birth. Age, education, religiosity, race/ethnicity, marital status, wanted pregnancy, planned pregnancy, and number of weeks pregnant did not predict birthing fears (p's>.11). Adjusted R^2 for model 1 was .43. Significant predictors in model 2 (psychological predictors) included only general anxiety ($b=1.00$, SE=0.23, $t=4.45$, $p<.001$). State anxiety evidenced a trend ($b=.34$, SE=.20, $t=1.72$, $p=.09$); depression did not predict fear of giving birth ($p=.84$). Adjusted R^2 for model 2 was .15. In the final combined model, STAI became fully non-significant, $p=.16$, and was therefore omitted. See Table 2b for the results of the final combined model, which explained 49% of the variance in the fear of giving birth scale.

3.3. What predicted fear of bearing a handicapped child?

For the PRAQ-R fear of bearing a handicapped child scale, significant predictors in model 1 included race/ethnicity ($b=-1.53$, SE=.58, $t=-2.64$, $p=.009$), and Marital Status ($b=-1.33$, SE=0.57, $t=-2.34$, $p=.02$) such that being non-white and married each independently predicted lower fear of bearing a handicapped child. Age, income, education, religiosity, parity, wanted pregnancy, planned pregnancy, and number of weeks pregnant did not predict handicapped child fears (p's>.13). Adjusted R^2 for model 1 was .08. Significant predictors in model 2 included general anxiety ($b=1.08$, SE=0.24, $t=4.49$, $p<.001$) and state anxiety ($b=0.91$, SE=0.27, $t=3.31$, $p=.001$) whereas

Table 2b
Final models for pregnancy anxiety (PRAQ-R) subscales.

	b	SE	*t*	*p*	
Fear of giving birth					
Final combined model, adjusted $R^2=.49$ (n=311)					*ΔR² if entered on first /last step*
Income	−0.44	0.13	−3.30	.001	.06/.02
General anxiety (PHQ-4)	0.96	0.14	7.12	<.001	.17/.08
Parity	−3.77	0.27	−13.76	<.001	.38/.31
Fear of bearing a handicapped child					
Final combined model, model adjusted $R^2=.24$ (n=289)					*ΔR² if entered on first /last step*
Race/Ethnicity	−1.46	0.51	−2.89	.004	0.02/0.02
Marital status	−1.24	0.44	−2.79	.006	0.05/0.02
State anxiety (STAI)	0.96	0.25	3.84	<.001	0.16/0.04
General anxiety (PHQ-4)	0.98	0.26	3.73	<.001	0.17/0.04
Pregnancy-related concerns about one's appearance					
Final combined model, model adjusted $R^2=.17$ (n=311)					
Wanted pregnancy	−1.55	0.44	−3.53	<.001	0.08/0.03
State anxiety (STAI)	1.03	0.17	5.97	<.001	0.15/0.10

depression was non-significant (b=0.29, SE=0.26, t=1.13, p=.26), with a model 2 Adjusted R^2 of .22. See Table 2b for the results of the final combined model, which explained 24% of the variance in the fear of bearing a handicapped child scale.

3.4. What predicted pregnancy-related concerns about one's appearance?

For the pregnancy-related concerns about one's appearance scale of the PRAQ-R, the only significant predictor in model 1 was a wanted pregnancy (b=−1.87, SE=0.59, t=−3.16, p=.002), such that wanting one's current pregnancy predicted lower pregnancy-related appearance concerns. Age, income, education, marital status, race/ethnicity, religiosity, parity, planned pregnancy, and number of weeks pregnant did not predict appearance concerns (p's>.12). Adjusted R^2 for model 1 was .06. The only significant predictor in model 2 was state anxiety (b=0.92, SE=0.20, t=4.56, p<.001), with a model 2 adjusted R^2 of .14. General anxiety and depression were non-significant (p's>0.22). See Table 2b for the results of the Final combined model, which accounted for 17% of the variance in the pregnancy-related concerns about one's appearance scale.

3.5. What predicts drinking risk during pregnancy? What role does pregnancy anxiety play in drinking risk during pregnancy?

The predictors of alcohol risk during pregnancy as a continuous variable are shown in Table 3a. Significant predictors in the final model included age, wanted pregnancy, and pregnancy anxiety; together they accounted for 13% of the variance in drinking risk. Pregnancy anxiety was the largest overall predictor of drinking risk, contributing ΔR^2=.10 if entered on the first step of the model and ΔR^2=.05 if entered on the last step. Lower age and higher pregnancy anxiety predicted higher drinking risk whereas wanting the pregnancy predicted lower drinking risk. *A priori* follow-up analyses of pregnancy anxiety subscales revealed that fear of bearing a handicapped child (b=0.20, p=.007), and fear of pregnancy-related impact on one's appearance (b=0.20, p=.01) positively predicted alcohol risk whereas fear of giving birth (b=−0.01, p=.89) did not.

The predictors of screening positively for drinking risk during pregnancy with a total score of 2+ are displayed in Table 3b. In the final model, age and marital status predicted positive screening, with lower age and non-married status associated with higher odds of screening positively. Although they did not reach full statistical significance, lower income (p=.05) and minority status (p=.05) predicted lower odds of screening positively whereas higher overall pregnancy anxiety (p=.07) predicted higher odds of screening positively. *A priori* follow-up analyses of pregnancy anxiety components revealed that fear of pregnancy-related impact on one's appearance (B=0.36,

Table 3a
T-ACE as a continuous predictor of drinking risk during pregnancy.

	b	SE	t	p
Model 1. Predictors, model adjusted R^2=.08				
Age	−0.28	0.09	−2.01	.05∗[a]
Income	0.12	0.09	1.34	.18
Education	−0.06	0.09	−0.73	.46
Religiosity	−0.02	0.08	−0.21	.83
Race/ethnicity	−0.36	0.18	−2.04	.04∗
Parity	−0.13	0.16	−0.82	.42
Marital status	−0.27	0.17	−1.56	.12
Pregnancy wanted	−0.55	0.23	−2.42	.02∗
Pregnancy planned	−0.01	0.18	−0.07	.95
Weeks pregnant	−0.02	0.07	−0.29	.77
Model 2 predictors, model adjusted R^2=.10				
State anxiety (STAI)	0.05	0.09	0.57	.57
Depression (PHQ-4)	0.17	0.10	1.73	.09
Anxiety (PHQ-4)	−0.13	0.11	−1.20	.23
Pregnancy anxiety (PRAQ-R total)	0.38	0.09	4.38	<.001∗∗∗

Final combined model[b], *model adjusted R^2=.13 (n=311)*	b	SE	t	p	ΔR^2 if entered on first /last step
Age	−0.16	0.07	−2.12	.04∗	.05/.01
Pregnancy wanted	−0.54	0.19	−2.89	.004∗∗	.07/.02
Pregnancy anxiety (PRAQ-R total)	0.30	0.08	4.01	<.001∗∗∗	.10/.05

∗ p<.05.
∗∗ p<.01.
∗∗∗ p<.001.
[a] p=.046.
[b] Race/ethnicity (white/nonwhite) was no longer significant in the final combined model, p=.11, and thus was omitted.

Exp[B]=1.43, 95% CI=1.08–1.89, p=.01) positively predicted a positive alcohol screening whereas fear of giving birth (B=−0.15, p=.31) and fear of bearing a handicapped child (B=0.12, p=.42) did not.

The predictors of screening positively for drinking risk during pregnancy with a total score of 3+ are displayed in Table 3c. In the final model, wanted pregnancy (Exp[B] 95% CI=0.16–0.77, p=.009) and general anxiety (Exp[B] 95%CI=0.12–0.75, p=.004) were associated with reduced odds of screening positively whereas depression (Exp[B] 95% CI=0.1.15–3.34, p=.01) and pregnancy anxiety (Exp[B] 95% CI=0.1.61-4.14, p<.001) were associated with greater odds of screening positively for risky drinking. Pregnancy anxiety served as the single largest predictor of screening positively for drinking risk. *A priori* follow-up analyses of pregnancy anxiety components revealed that fear of bearing a handicapped child (B=0.59, Exp[B]=1.80, 95% CI=1.18–2.74, p=.007) positively predicted a positive alcohol screening whereas concerns about the impact of pregnancy on one's appearance (B=0.40, Exp[B]=1.48, 95% CI=0.96–2.30, p=.08) and fear of giving birth (B=0.28, Exp[B]=1.32, 95% CI=0.84–2.06, p=.22) did not.

Table 3b
T-ACE (total score of 2+) as a dichotomous screener of drinking risk during pregnancy.

	B	SE	Exp(B)	95% CI for Exp(B)	p
*Model 1 predictors**					
Age	−0.58	0.17	0.56	0.40–0.79	.001**
Income	0.28	0.17	1.32	0.95–1.84	.10
Education	0.03	0.16	1.03	0.75–1.40	.86
Religiosity	−0.04	0.14	0.96	0.74–1.26	.78
Race/Ethnicity	−0.66	0.33	0.52	0.27–0.99	.05*[a]
Parity	0.04	0.30	1.04	0.58–1.87	.89
Marital status	−0.64	0.31	0.53	0.29–0.97	.04*
Pregnancy wanted	−0.39	0.40	0.68	0.31–1.48	.32
Pregnancy planned	−0.18	0.32	0.83	0.44–1.56	.57
Weeks pregnant	0.01	0.13	1.01	0.78–1.30	.95
Model 2 predictors					
State anxiety (STAI)	0.09	0.15	1.10	0.81–1.47	.55
Depression (PHQ-4)	0.00	0.16	1.00	0.74–1.37	.98
Anxiety (PHQ-4)	0.07	0.17	1.08	0.77–1.51	.68
Pregnancy anxiety (PRAQ-R total)	0.38	0.15	1.46	1.10–1.95	.009**
Final combined model (n=289)					
Age	−0.57	0.16	0.57	0.42–0.78	<.001***
Income[b]	0.30	0.15	1.35	1.0–1.83	.05
Race/Ethnicity	−0.63	0.32	0.54	0.29–1.00	.05
Marital status	−0.64	0.30	0.53	0.30–0.95	.03*
Pregnancy anxiety (PRAQ-R total)	0.25	0.14	1.28	0.98–1.68	.07

* *p*<.05.
** *p*<.01.
*** *p*<.001.
[a] *p*=.046.
[b] We retested and kept *Income* as a predictor of positive T-ACE screening in the final combined model because it was borderline significant (*p*=.096) and overlaps significantly with *Education*. With *Education* removed in the final combined model, we wanted to examine whether *Income* would better predict the outcome, which it did. We kept pregnancy anxiety in the final model because it represented the principal predictor of interest.

4. Discussion

Within a national US sample, we aimed to investigate the sociodemographic, pregnancy, and mental health-related predictors of pregnancy anxiety. Second, we examined the associations between pregnancy anxiety and risk for significant alcohol use during pregnancy, controlling for a broad range of sociodemographic and other variables. Whereas we did not make specific predictions regarding our first aim, we predicted that pregnancy anxiety would predict risk for significant alcohol use during pregnancy.

4.1. Predictors of pregnancy anxiety

For predictors of pregnancy anxiety, we found that greater education, parity (having no previous children), higher state anxiety and higher general anxiety predicted higher overall pregnancy anxiety, accounting for 41% of its variance.

Depending on the order of entry into the equation, effect sizes ranged from small to medium for education, medium to large for parity, and medium to very large for state anxiety and general anxiety. Our results differ somewhat from those of Gurung et al. [21] who found that parity did not predict pregnancy anxiety; however, Gurung et al. employed a more general measure of pregnancy anxiety within a predominantly ethnic /racial minority sample.

For predictors of specific domains of pregnancy anxiety, we found that lower income, higher general anxiety, and parity (having no previous children) predicted greater fear of giving birth and accounted for a colossal 49% of its variance. The effect sizes of contributions to fear of giving birth varied from small to medium for income, medium to large for general anxiety, and very large for parity. Logically, having birthed other children likely increases knowledge, realistic expectations, and self-efficacy regarding birthing (at least if previous births went well), thus serving as a strong protective factor for fear of birthing. Facing birth for the first time, on the other hand, involves many anxiety-provoking unknowns. Higher income may lower fears of giving birth because of greater access to birthing resources such as professional support (e.g., doulas) and greater number and quality of choices regarding where and therefore how one gives birth.

Table 3c
T-ACE (total score of 3+) as a dichotomous screener of drinking risk during pregnancy.

	B	SE	Exp(B)	95% CI for Exp(B)	p
*Model 1 predictors**					
Age	0.29	0.24	1.34	0.84-2.13	.22
Income	0.19	0.27	1.21	0.71–2.06	.49
Education	−0.43	0.26	0.65	0.39–1.09	.10
Religiosity	−0.02	0.23	0.98	0.62–1.53	.92
Race/Ethnicity	−0.53	0.56	0.59	0.20–1.75	.34
Parity	−0.88	0.54	0.42	0.15–1.20	.10
Marital Status	−0.64	0.49	0.53	0.20–1.37	.19
Pregnancy Wanted	−1.33	0.58	0.27	0.09–0.82	.02*
Pregnancy Planned	0.07	0.57	1.07	0.35–3.25	.91
Weeks pregnant	−0.06	0.21	0.94	0.62–1.43	.78
Model 2 Predictors					
State Anxiety (STAI)	0.06	0.24	1.07	0.67–1.70	.79
Depression (PHQ-4)	0.68	0.27	1.97	1.17–3.31	.01*
Anxiety (PHQ-4)	−0.85	0.31	0.43	0.24–0.78	.006**
Pregnancy Anxiety (PRAQ-R total)	1.02	0.24	2.78	1.73–4.46	<.001***
Final Combined Model (n=311)					
Wanted	−1.04	0.40	0.35	0.16–0.77	.009**
Depression (PHQ-4)	0.67	0.27	1.96	1.15–3.34	.01*
General Anxiety (PHQ-4)	−0.89	0.31	0.41	0.23–0.75	.004**
Pregnancy Anxiety (PRAQ-R total)	0.95	0.24	2.58	1.61–4.14	<.001***

* *p*<.05.
** *p*<.01.
*** *p*<.001.

Regarding fear of bearing a handicapped child, being white, unmarried, and having higher state and general anxiety served as independent risk factors, accounting for 25% of the variance in fear of bearing a handicapped child. Higher state anxiety (medium to large effect) and general anxiety (medium to large effect) represented the largest predictors of handicapped child fears; race/ethnicity (small effect) and marital status (small to medium effect) represented more modest predictors. Being unmarried may result in greater anxiety due to imagining the greater time and financial demands that often accompany a child with special needs, within a couple that is less formally committed. Interestingly, ethnic and racial minority women as a group worried less than white women about bearing a handicapped child, although the effects were modest. The relatively small numbers within each minority group did not permit an examination of whether this was true for some minority groups but not others.

For pregnancy-related concerns about one's appearance, unwanted pregnancy (small to medium effect) and state anxiety (medium to large effect) served as the only significant predictors, together accounting for 17% of the variance in appearance-related concerns. Perhaps not wanting one's pregnancy leads to greater resentment and anxiety regarding the weight gain, water retention, and other physical changes associated with pregnancy that run counter to Western society's "beauty" and "thinness" ideals.

The role of state anxiety and general anxiety in the current study parallels the examination of state and trait anxiety by Huizink et al. [28] in their examination of the three subscales of the Pregnancy-Related Anxiety Questionnaire Revised (PRAQ-R). In general, we found that state and general anxiety contributed more significantly to pregnancy anxiety (PRAQ-R) outcomes, in the range of 15%–26% when entered first in the equation, compared with the findings of Huizink et al. Even at these levels of contribution, however, pregnancy anxiety appears to represent a largely distinct construct. Further, we examined the independent contribution of depression and found that it did not predict any dimension of pregnancy anxiety. We therefore echo the conclusion of Huizink et al. that pregnancy anxiety (as assessed by the PRAQ-R) appears to serve as a largely distinct construct independent of both depression and other forms of anxiety. On the other hand, it is possible that pregnancy anxiety serves as a "lightening rod" for women who tend to experience high anxiety in general. Within the context of pregnancy, that is, high trait anxious women may direct their anxiety toward pregnancy-related concerns. Prior to and following pregnancy, high anxiety may be directed elsewhere (e.g., toward worrying about finances, children, relationships, world affairs, etc.). From this perspective, assessing pregnancy anxiety may represent the best way to elicit anxiety levels when women are pregnant. The possibility remains, therefore, that pregnancy anxiety does not tap a unique or independent construct but rather serves as a focal point during pregnancy for elevated anxiety more

generally. Longitudinal studies that extend from pre-pregnancy through postpartum are needed to address this possibility, and to thoroughly differentiate between pregnancy anxiety and underlying trait anxiety or anxiety disorder symptoms.

Paralleling the previous findings of Gurung et al. [21], we also found that pregnancy stage did not predict pregnancy anxiety. Finally, our analyses demonstrated that each dimension of pregnancy anxiety associated with a relatively unique set of predictors, suggesting that pregnancy anxiety is not entirely a unitary construct. That is, different women worry about different aspects of being pregnant.

4.2. Pregnancy anxiety and risk of significant alcohol use

Within two of three analyses, pregnancy anxiety served the single most robust predictor of risk for significant alcohol use during pregnancy (as assessed by the T-ACE) from among the many sociodemographic, pregnancy-related, and mental health-related variables we examined. Importantly, pregnancy anxiety better predicted drinking risk during pregnancy than did depression or other forms of anxiety. Further, findings revealed an interesting difference between pregnancy anxiety and general anxiety in relation to drinking risk.

For drinking risk as a continuous variable, lower age, unwanted pregnancy, and higher pregnancy anxiety predicted higher drinking risk during pregnancy. Age (small to medium effect) and unwanted pregnancy (small to medium effect) accounted for modest amounts of variance in drinking risk. Pregnancy anxiety accounted for a moderate amount of variance (medium to large effect) representing the largest predictor of drinking risk even with the other significant predictors in the model.

The T-ACE is more typically employed as a dichotomous screener for drinking risk during pregnancy, with total score cutoffs ranging from 2 to 3 [11,54]. At the usual total score cutoff of 2, pregnancy anxiety did not reach full significance as a predictor of screening positively for high drinking risk during pregnancy ($p=.07$). Rather, age and marital status were the only significant predictors. Younger and unmarried women were at greater odds for screening positively for risky drinking during pregnancy. This finding is consistent with epidemiological findings that younger age and unmarried status predict heavier alcohol use and greater risk of alcohol use disorders among both pregnant and non-pregnant women [8,26].

Recent work, however, suggests that a total score cutoff of 3 on the T-ACE greatly improves the poor specificity associated with the traditional cutoff of 2 without compromising sensitivity [11]. At a cutoff of 3, pregnancy anxiety again emerged as a robust predictor of drinking risk during pregnancy, predicting 1.6 to 4.1 greater odds of screening positively on the T-ACE.[5] Interestingly, general anxiety also predicted positive screening on the T-ACE, but in the opposite direction. Whereas pregnancy anxiety was

associated with significantly *higher* odds of risky drinking, general anxiety was associated with significantly *lower* odds of risky drinking during pregnancy (with both predictors in the model). This pair of findings suggests that the pregnancy-specific component of anxiety is uniquely associated with higher drinking risk during pregnancy. This has important implications for mental health, obstetrics, and primary care practitioners, in that being anxious about pregnancy should be specifically assessed. Depression was associated with greater risk of screening positively (odds 1.2–3.3) but not to the same degree as pregnancy anxiety.

Which domains of pregnancy anxiety account for elevated drinking risk? Fear of bearing a handicapped child and pregnancy-related appearance concerns each predicted two out of three drinking risk outcomes, whereas fear of giving birth did not predict even a single drinking risk outcome. Thus, distinct domains of pregnancy anxiety differentially predicted drinking risk. To speculate, it may be easier to readily access opportunities to cope with fear of giving birth through birth classes offered by most hospitals. Fewer hospital resources may be available to cope with fears of bearing a handicapped child or pregnancy-related appearance concerns (for even with invasive prenatal genetic testing, handicapped children can result from birth-related incidents); therefore, these fears may be more difficult to alleviate. These findings suggest that it may be particularly important for mental health practitioners and obstetricians to inquire about and support patients regarding fears of bearing a handicapped child and fears of pregnancy-related impact on one's appearance. Obstetricians could probe these concerns in the context of discussing the importance of good prenatal care more generally, including taking prenatal vitamins, managing a healthy diet, gaining weight appropriately, avoiding alcohol and drugs, keeping prenatal appointments, and completing prenatal diagnostic testing.

Our findings regarding the uniquely robust relationship between pregnancy anxiety and risk for significant alcohol use during pregnancy may help to explain some of the previously demonstrated associations between antenatal anxiety and negative child outcomes. Studies on the association between pregnancy anxiety and birth/child outcomes generally have not accounted for alcohol use during pregnancy (e.g., Refs. [31,48,59-61]) or have defined alcohol use conservatively as one or more units per day in the first three months of pregnancy [44-46,53]. Research on growth deficits and negative behavioral outcomes, however, has shown that any alcohol consumption during pregnancy [14,55] and certainly consumption at levels *lower than* one or more drinks per day can negatively impact fetal, infant, and child development. Even light drinking in the third trimester, which was not assessed in most previous studies, leads to increased risk of pre-term birth (e.g., Ref. [39]), a negative outcome strongly linked with pregnancy anxiety [18]. In fact, a recent study by Dunkel-Schetter and colleagues [19] (as cited in Dunkel-Schetter, 2011) in a large sample of Mexican-origin, low-income women, demonstrated that increased risk of pre-term birth due to high stress was no longer significant once alcohol and substance use were controlled for. These results suggest that risky health behaviors such as alcohol and substance use during pregnancy may mediate the relationship between pregnancy anxiety and elevated risk of pre-term birth.

4.3. Study limitations

The major limitation of the current study is that we utilized a cross-sectional sample and therefore could not establish the temporal relationship between our predictor and outcome variables. We therefore used the word "predictor" only in the statistical sense because within our cross-sectional sample causative or true predictive relationships could not be determined. The possibility remains, therefore, that drinking during pregnancy predicted pregnancy anxiety rather than vice versa (pregnancy anxiety predicting risky drinking). The finding that pregnant-related changes in one's appearance strongly associated with drinking risks during pregnancy, however, does not easily fit with this possibility. Although it makes sense that women at risk for significant drinking during pregnancy might worry more about bearing a handicapped child (for good medical reasons), it does not stand that they would worry more about their appearance. Longitudinal studies are now needed to pinpoint the direction of the relationship between pregnancy anxiety and drinking risk over time. Second, we did not control for medical risk factors, as has been recommended by Dunkel-Schetter [18]. Medical risk factors have significantly predicted pregnancy anxiety in previous studies (e.g., Ref. [21]) and should be accounted for in future replication efforts. Third, racial and ethnic minorities represented 23.5% of the current sample whereas the 2010 Census indicates that 30.9% of the US population identifies as a racial or ethnic minority. Blacks/African Americans and Latinos in particular were underrepresented in the present study; caution should be undertaken when generalizing to these groups. Future studies should also examine racial/ethnic groups individually, which we could not due to limited group sizes, as well as assess the predictive potential of communalism, which recent work shows is a robust culture-related predictor of mental health during pregnancy [1]. Fourth, we utilized an Internet sample in order to draw from a fully national sample of pregnant women. Although researchers in psychiatry and medicine are increasingly using the Internet to study (e.g., Ref. [5]) and treat patients (e.g., Ref. [50]), results should be replicated in clinic samples. Fifth, we aimed to minimize participant burden and therefore utilized brief measures for each psychological construct of interest. Each of our

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[5] In this and all other reported findings, additional significant predictors were included in the models; therefore, each result is independent and parsed from the variance shared with other predictors.

measures, however, evidenced good psychometrics particularly given their brief length. Future studies would benefit, nonetheless, from comparing the current results with results obtained with longer measures such as the Edinburgh Postpartum Depression Scale [13] to assess depression rather than the ultra-brief measure of depression used presently [33]. More in-depth measures of alcohol use and risk during pregnancy should also be employed to supplement the T-ACE in future studies (see Burns et al. [6]). Finally, due to our interest in examining specific predictors for each domain of pregnancy anxiety, we reported many statistical analyses. A large portion of the results, however, represented model building regression steps for a limited number of outcomes. Thus, the total number of dependent variables remained relatively small. Further, we reported effect sizes throughout the paper, and found moderate to large effects for the main predictors of interest (e.g., pregnancy anxiety and the other mental health constructs).

5. Conclusion

In a national US sample of adult pregnancy women, we replicated previous findings [28] that pregnancy anxiety as measured by the PRAQ-R represents a unique construct that is largely independent from depression and other forms of anxiety. We further demonstrated that each dimension of pregnancy anxiety is accounted for by a different set of predictors, suggesting that pregnancy anxiety is not entirely unitary and that different women endorse different pregnancy-related concerns. Finally, pregnancy anxiety predicted important consequences. Pregnancy anxiety emerged as the largest predictor of significant alcohol consumption risk during pregnancy in two out of three analyses. In summary, pregnancy anxiety represents a unique set of fears associated with important alcohol-related risks during pregnancy. Mental health and obstetrics practitioners can act on these findings by inquiring about and supporting pregnant patients regarding pregnancy-related fears and concerns.

References

[1] Abdou CM, Schetter CD, Campos B, Hilmert CJ, Dominguez TP, Hobel CJ, Sandman CA. Communalism predicts maternal affect, stress, and physiology better than ethnicity and SES. Cultur Divers Ethnic Minor Psychol 2010;16(3):395-403.

[2] Alder J, Fink N, Bitzer J, Hösli I, Wolfgang H. Depression and anxiety during pregnancy: a risk factor for obstetric, fetal and neonatal outcome? A critical review of the literature. J Matern Fetal Neonatal Med 2007;20(3):189-209.

[3] Bagheri MM, Burd L, Martsolf JT, Klug MG. Fetal alcohol syndrome: maternal and neonatal characteristics. J Perinat Med 2009;26(4): 263-9.

[4] Behrend TS, Sharek DJ, Meade AW, Wiebe EN. The viability of crowdsourcing for survey research. Behav Res Methods 2011;43(3):800-13, http://dx.doi.org/10.3758/s13428-011-0081-0.

[5] Bennett RM, Jones J, Turk DC, Russell IJ, Matallana L. An Internet survey of 2,596 people with fibromyalgia. BMC Musculoskelet Disord 2007;8(27):1-11.

[6] Burns E, Gray R, Smith LA. Brief screening questionnaires to identify problem drinking during pregnancy: a systematic review. Addiction 2010;105(4):601-14, http://dx.doi.org/10.1111/j.1360-0443.2009.02842.x.

[7] Buss C, Davis EP, Muftuler LT, Head K, Sandman CA. High pregnancy anxiety during mid-gestation is associated with decreased gray matter density in 6–9-year-old children. Psychoneuroendocrinology 2010;35(1):141-53, http://dx.doi.org/10.1016/j.psyneuen.2009.07.010.

[8] Caetano R, Ramisetty-Mikler S, Floyd LR, McGrath C. The epidemiology of drinking among women of child-bearing age. Alcohol Clin Exp Res 2006;30(6):1023-30.

[9] Chang G. Alcohol-screening instruments for pregnant women. Alcohol Res Health 2001;25(3):204-9.

[10] Chang G, Wilkins-Haug L, Berman S, Goetz MA, Behr H, Hiley A. Alcohol use and pregnancy: improving identification. Obstet Gynecol 1998;91(6):892-8.

[11] Chiodo LM, Sokol RJ, Delaney-Black V, Janisse J, Hannigan JH. Validity of the T-ACE in pregnancy in predicting child outcome and risk drinking. Alcohol 2010;44(7–8):595-603, http://dx.doi.org/10.1016/j.alcohol.2009.08.009.

[12] Conger JJ. Reinforcement theory and the dynamics of alcoholism. Q J Stud Alcohol 1956;17:296-305.

[13] Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. Br J Psychiatry 1987;150:782-6.

[14] Day NL, Richardson GA. An analysis of the effects of prenatal alcohol exposure on growth: a teratologic model. American Journal of Medical Genetics Part C127C 2004;127C:28-34.

[15] De Beuckelaer A, Lievens F. Measurement equivalence of paper-and-pencil and Internet organisational surveys: a large scale examination in 16 countries. Applied Psychology: An International Review 2009; 58(2):336-61.

[16] DiPietro JA, Ghera MM, Costigan K, Hawkins M. Measuring the ups and downs of pregnancy stress. J Psychosom Obstet Gynecol 2004;25:189-201.

[17] DiPietro JA, Hilton SC, Hawkins M, Costigan KA, Pressman EK. Maternal stress and affect influence fetal neurobehavioral development. Dev Psychol 2002;38(5):659-68.

[18] Dunkel-Schetter C. Stress processes in pregnancy and pretern birth. Current Directions in Psychological Science 2009;18(4):205-9.

[19] Dunkel-Schetter, C., J., P., M.C., L., Collins, N., Scrimshaw, S. C. M., & Zambrana, R. E. (2010, as cited in Dunkel-Schetter, 2011). Psychosocial stress and preterm delivery in pregnant women of Mexican origin and descent. Unpublished manuscript, University of California Los Angeles.

[20] Greeley J, Oei T. Alcohol and tension reduction. In: Leonard KE, & Blane HT, editors. Psychological theories of drinking and alcoholism. . New York, NY: The Guilford Press; 1999.

[21] Gurung RAR, Dunkel-Schetter C, Collins N, Rini C, Hobel CJ. Psychosocial predictors of prenatal anxiety. Journal of Social and Clinical Psychology 2005;24(4):497-519.

[22] Gutteling BM, de Weerth C, Willemsen-Swinkels SHN, Huizink AC, Mulder EJH, Visser GHA, Buitelaar JK. The effects of prenatal stress on temperament and problem behavior of 27-month-old toddlers. Eur Child Adolesc Psychiatry 2005;14(1):41-51, http://dx.doi.org/10.1007/s00787-005-0435-1.

[23] Guttman. Premium and protection of several procedures for dealing with outliers when sample sizes are moderate and large. Technometrics 1973;15:385-404.

[24] Hanson JW, Jones KL, Smith DW. Fetal alcohol syndrome. J Am Med Assoc 1976;235(14):1458-60.

[25] Heron J, O'Connor TG, Evans J, Golding J, Glover V, Team tAS. The course of anxiety and depression through pregnancy and the postpartum in a community sample. J Affect Disord 2004;80:65-73.

[26] Hill EM, Chow K. Life-history theory and risky drinking. Addiction 2002;97(4):401-13.

[27] Huizink AC, de Medina PG, Mulder EJ, Visser GH, Buitelaar JK. Psychological measures of prenatal stress as predictors of infant temperament. J Am Acad Child Adolesc Psychiatry 2002;41(9): 1078-85.

[28] Huizink AC, Mulder EJ, Robles de Medina PG, Visser GH, Buitelaar JK. Is pregnancy anxiety a distinctive syndrome? Early Hum Dev 2004;79:81-91.

[29] Huizink AC, Robles de Medina PG, Mulder E, Visser GH, Buitelaar JK. Stress during pregnancy is associated with developmental outcome in infancy. Journal of Child Psychology and Psychiatry 2003;44:810-8.

[30] Kinsella MT, Monk C. Impact of maternal stress, depression and anxiety on fetal neurobehavioral development. Clin Obstet Gynecol 2009;52(3):425-40.

[31] Kramer MS, Lydon J, Seguin L, Goulet L, Kahn SR, McNamara H, Platt RW. Stress pathways to spontaneous preterm birth: the role of stressors, psychological distress, and stress hormones. Am J Epidemiol 2009;169(11):1319-26.

[32] Krantz JH, Dalal R. Validity of Web-based psychological research. In: & Birnbaum MH, editor. Psychological experiments on the Internet. San Diego: Academic Press; 2000. p. 35-57.

[33] Kroenke K, Spitzer RL, Williams JB, Lowe B. An ultra-brief screening scale for anxiety and depression: the PHQ-4. Psychosomatics 2009;50(6):613-21.

[34] Kroenke K, Spitzer RL, Williams JBW, Lowe B. The Patient Health Questionnaire Somatic, Anxiety, and Depressive Symptom Scales: a systematic review. Gen Hosp Psychiatry 2010;32(4):345-59.

[35] Kroenke K, Spitzer RL, Williams JBW, Monahan PO, Lowe B. Anxiety disorders in primary care: prevalance, impairment, comorbidity, and detection. Ann Intern Med 2007;146:317-25.

[36] Lobel M. Conceptualizations, measurement, and effects of prenatal maternal stress on birth outcomes. J Behav Med 1994;17:225-72.

[37] Lobel M, Cannella DL, Graham JE, DeVincent C, Schneider J, Meyer BA. Pregnancy-specific stress, prenatal health behaviors, and birth outcomes. Health Psychol 2008;27(5):604-15.

[38] Lowe B, Kroenke K, Grafe K. Detecting and monitoring depression with a two-item questionnaire (PHQ-2). J Psychosom Res 2005;58(2): 163-71.

[39] Lundsberg LS, Bracken MB, Saftlas AF. Low-to-moderate gestational alcohol use and intrauterine growth retardation, low birthweight, and preterm delivery. Ann Epidemiol 1997;7(7):498-508.

[40] Mancuso RA, Dunkel-Schetter C, Rini CM, Roesch SC, Hobel CJ. Maternal prenatal anxiety and corticotropin-releasing hormone associated with timing of delivery. Psychosom Med 2004;66:762-9.

[41] Marteau T, Bekker H. The development of a six-item short-form of the state scale of the Spielberger State-Trait Anxiety Inventory (STAI). Br J Psychol 1992;31(3):301-6.

[42] Meshberg-Cohen S, Svikis D. Panic disorder, trait anxiety, and alcohol use in pregnant and nonpregnant women. Compr Psychiatry 2007;48(6):504-10, http://dx.doi.org/10.1016/j.comppsych.2007.06.004.

[43] Mukherjee RAS, Hollins S, Abou-Saleh MT. Low level alcohol consumption and the fetus. Br Med J 2005;330:375-6.

[44] O'Connor TG, Heron J, Glover V. Antenatal anxiety predicts child behavioral/emotional problems independently of postnatal depression [peer reviewed]. J Am Acad Child Adolesc Psychiatry 2002;41(12):1470-7, http://dx.doi.org/10.1097/00004583-200212000-00019.

[45] O'Connor TG, Heron J, Golding J, Beveridge M, Glover V. Maternal antenatal anxiety and children's behavioural/emotional problems at 4 years: report from the Avon Longitudinal Study of Parents and Children. Br J Psychiatry 2002;180(6):502-8, http://dx.doi.org/10.1192/bjp. 180.6.502.

[46] O'Connor TG, Heron J, Golding J, Glover V. Maternal antenatal anxiety and behavioural/emotional problems in children: a test of a programming hypothesis. Journal of Child Psychology and Psychiatry 2003;44(7):1025-36, http://dx.doi.org/10.1111/1469-7610.00187.

[47] Rini CK, Dunkel-Schetter C, Sandman CA, Wadhwa PD. Psychological adaptation and birth outcomes: the role of personal resources, stress, and sociocultural context in pregnancy. Health Psychol 1999; 18:333-45.

[48] Rini CK, Dunkel-Schetter C, Wadhwa PD, Sandman CA. Psychological adaptation and birth outcomes: the role of personal resources, stress, and sociocultural context in pregnancy. Health Psychol 1999;18(4):333-45, http://dx.doi.org/10.1037/0278-6133.18.4.333.

[49] Ritter P, Lorig K, Laurent D, Matthews K. Internet versus mailed questionnaires: a randomized comparison. J Med Internet Res 2004;6(3) doi:10.2196/jmir.6.3.e29.

[50] Ritterband LM, Thorndike FP, Gonder-Frederick LA, Magee JC, Bailey ET, Saylor DK, Morin CM. Efficacy of an Internet-based behavioral intervention for adults with insomnia. Arch Gen Psychiatry 2009;66(7):692-8.

[51] Robertson E, Grace S, Wallington T, Stewart DE. Antenatal risk factors for postpartum depression: a synthesis of recent literature. Gen Hosp Psychiatry 2004;26(4):289-95.

[52] Roesch SC, Dunkel-Schetter C, Woo G, Hobel CJ. Modeling the types and timing of stress in pregnancy. Anxiety Stress Coping 2004;17:87-102.

[53] Sarkar P, Bergman K, O'Connor TG, Glover V. Maternal antenatal anxiety and amniotic fluid cortisol and testosterone: possible implications for foetal programming [peer reviewed]. J Neuroendocrinol 2008;20(4):489-96, http://dx.doi.org/10.1111/j.1365-2826.2008.01659.x.

[54] Sokol RJ, Mairtier SS, Ager JW. The T-ACE questions: practical prenatal detection of risk-drinking. Am J Obstet Gynecol 1989;160: 863-71.

[55] Sood B, Delaney-Black V, Covington C, Nordstrom-Klee B, Ager J, Templin T, Sokol RJ. Prenatal alcohol exposure and childhood behavior and age 6 to 7 years: I. Dose–response effect. Pediatrics 2001; 108(2):1-9.

[56] Spielberger CD, Gorsuch RL, Lushene R, Vagg PR, Jacobs GA. Manual for the State-Trait Anxiety Inventory, STAI (Form Y). Palo Alto, CA: Mind Garden; 1983.

[57] Teixeira JM, Fisk NM, Glover V. Association between maternal anxiety in pregnancy and increased uterine artery resistance index: cohort based study. BMJ 1999;318(7177):153-7.

[58] Tluczek A, Henriques JB, Brown RL. Support for the reilability and validity of a six-item state anxiety scale derived from the State-Trait Anxiety Inventory. J Nurs Meas 2009;17(1):19-28.

[59] van den Bergh BR, Marcoen A. High antenatal maternal anxiety is related to ADHD symptoms, externalizing problems, and anxiety in 8- and 9-year-olds. Child Dev 2004;75(4):1085-97, http://dx.doi.org/10.1111/j.1467-8624.2004.00727.x.

[60] van den Bergh BR, Mennes M, Oosterlaan J, Stevens V, Stiers P, Marcoen A, Lagae L. High antenatal maternal anxiety is related to impulsivity during performance on cognitive tasks in 14- and 15-year-olds. Neurosci Biobehav Rev 2005;29(2):259-69, http://dx.doi.org/10.1016/j.neubiorev.2004.10.010.

[61] van den Bergh BR, Mennes M, Stevens V, van der Meere J, Borger N, Stiers P, Lagae L. ADHD deficit as measured in adolescent boys with a continuous performance task is related to antenatal maternal anxiety. Pediatr Res 2006;59(1):78-82, http://dx.doi.org/10.1203/01.pdr.0000191143.75673.52.

[62] van den Bergh BR, Mulder EJH, Mennes M, Glover V. Antenatal maternal anxiety and stress and the neurobiological development of the fetus and child: links and possible mechanisms. A review. Neurosci Biobehav Rev 2005;29(2):237-58.

[63] van den Bergh BR, Van Calster B, Smits T, Van Huffel S, Lagae L. Antenatal maternal anxiety is related to HPA-axis dysregulation and self-reported depressive symptoms in adolescence: a prospective study on the fetal origins of depressed mood. Neuropsychopharmacology 2008;33(3):536-45, http://dx.doi.org/10.1038/sj.npp. 1301450.

[64] Ventura AJ, Abma JC, Mosher WD, Henshaw S. Estimated pregnancy rates for the United States, 1990–2000: an update. National Vital Statistics Report 2004;52(23):1-12.

[65] Young RM, Oei TPS, Knight RG. The tension reduction hypothesis revisited: an alcohol expectancy perspective. Br J Addict 1990;85:31-40.