

# Examining the Psychometric Properties of Three Standardized Screening Tools in a Pregnant and Parenting Population

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**Abstract** *Significance* Although standardized tools such as the Spielberger State Anxiety scale (1970) and Cohen's Perceived Stress Index (1983) have often been used in pregnant and postpartum populations to evaluate psychosocial risk, there exists very little literature on the reliability of these scales in this population. Given the potentially grave consequences of undiagnosed pre and postpartum mental distress, it is of paramount importance that the tools that are commonly used are evaluated for their psychometric properties within the pregnant and parenting population. *Methods* The psychometric properties of three mental health scales were evaluated using the All Our Babies data. The All Our Babies cohort is a prospective longitudinal study based in Calgary, Alberta. A total of 3300 women were recruited from prenatal care sites from all four quadrants of the city. Participants were mailed questionnaires at 24–26 weeks gestation, 34–36 weeks and at 4 months postpartum. Reliability for the Spielberger State Anxiety Scale, the Perceived Stress Index and the Life Optimism Test—revised were evaluated

by calculating Cronbach's alphas. Validity with related constructs were tested for the State Anxiety Scale and the Perceived Stress Index by calculating Pearson Correlation Coefficients with closely related constructs. Sample size varied from 2670 to 3376, according to the response rate and time point. Depression as a related construct was evaluated using the Edinburgh Postpartum Depression Scale. *Results* The Cronbach's Alphas for the Spielberger State Anxiety scale were 0.92, 0.92 and 0.93 for 24–26 weeks, 34–36 weeks and 4 months postpartum respectively. The Alpha's for the Perceived Stress index were 0.88, 0.88 and 0.89 respectively. The Life Optimism Test Revised was only measured in the third trimester and the Cronbach's alpha was 0.83. The Pearson Correlation Coefficient for Anxiety with depression were  $r = 0.73$ ,  $r = 0.72$  and  $r = 0.77$  respectively. The coefficients for stress and depression were  $r = 0.75$ ,  $r = 0.75$  and  $r = 0.77$  respectively. *Discussion/Conclusion* The psychometric properties for all three scales were strong, with alphas that were comparable or higher to literature values. These data provide evidence that the use of these scales, previously validated in other populations are appropriate for use in among pregnant and parenting women at risk for mental distress.

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## Significance

Although mental health is frequently assessed during the perinatal period, scales that assess stress and anxiety have not been extensively validated in this population. This study contributes to the growing body of evidence to

support the use of the Spielberger State Anxiety Scale and the 10 item Perceived Stress Index with the pregnant and parenting population.

## Introduction

The perinatal period is a vulnerable time and many women will experience prenatal and/or postpartum depression and anxiety, or will find themselves experiencing difficulty coping with newfound stressors (Matthey et al. 2003; Austin 2004; Wenzel et al. 2005; Priest et al. 2008).

Defined as a major depressive episode occurring any time during pregnancy and the 12 months after birth, perinatal and postpartum depression are significant contributors to maternal mental morbidity (Warner et al. 1996). Postpartum depression is estimated to affect as many 5–20 % of new mothers, with many of those affected also experiencing depressive episodes during pregnancy (Matthey et al. 2003; Austin 2004; Wenzel et al. 2005; Priest et al. 2008). The large variation in prevalence can be in part attributed to variations in the definitions and diagnoses of depression. In a systematic review by Gavin et al. (2012), the period prevalence of postpartum depression in the first 3 months after birth was found to be as high as 19.2 % when both major and minor depression was taken into account. In Calgary, the Community Perinatal Care study estimated the prevalence of major depression to be approximately 11 % of new mothers, which is consistent with Canadian estimates of 8–9 % (Tough et al. 2008; Lanes et al. 2011). Post partum depression is distinct from the sub-clinical “baby blues” that often occurs within a few days of giving birth and generally does not persist nor require treatment.

Perinatal and postpartum anxiety is highly co-morbid with depression, and may have causal associations (Heron et al. 2004). Anxiety in pregnancy is also moderately stable; most women who are anxious during pregnancy may also experience elevated anxiety in the postpartum period (Heron et al. 2004). Psychosocial stress is also a significant contributing factor to maternal mental health morbidity, and may be associated with poor fetal outcomes, including preterm birth (Hobel et al. 2008; McDonald et al. 2014). Furthermore, treating anxiety, depression, and stress as distinct states does not allow for investigation into the effects of psychosocial loading. In particular, cumulative psychosocial stress has been implicated as an independent risk factor for late preterm birth (McDonald et al. 2014).

In addition to social support, emotional resiliency is an important buffer for psychosocial distress. Dispositional optimism, as measured by the Life Optimism Test-Revised is a measure of resiliency and emotional stability. McDonald et al. (2014) conceptualized dispositional optimism as a measure of internal coping mechanisms and a sense of

personal control. In their study, optimism was found to have significant buffering effects, reducing the risk of late preterm birth, even in the presence of significant psychosocial loading.

Screening for post partum depression is primarily done using the Edinburgh Postnatal Depression Scale (Cox et al. 1987), which has been validated in both antenatal and postnatal populations. However, other tools commonly used to screen for the different forms of postpartum distress such as anxiety and excess stress have not been as rigorously examined within a pregnant and parenting population. Although standardized tools such as the Spielberger State Anxiety scale (1970) and Cohen’s Perceived Stress Index (1983) have often been used in pregnant and postpartum populations to evaluate psychosocial risk, few studies have been conducted on the reliability and validity of these scales in this population. The State Anxiety subscale was validated in a prospective pregnancy cohort in Australia, however, the scale was not assessed for stability over time, nor for both pregnancy and postpartum (Grant et al. 2008). The 10 item Perceived Stress Index scale was validated in an Arabic speaking population (Chaaya et al. 2010), however, correlations with anxiety were not assessed.

The purpose of this study was to examine the internal consistency and reliability of commonly used tools for distress, specifically the 10 item Perceived Stress Scale, and the State Anxiety Inventory, as well the Life Orientation Test-Revised using a community-based cohort of pregnant women with longitudinal follow-up to determine their performance in the perinatal population.

## Methods

To assess the psychometric properties of the Perceived Stress Index, State Anxiety Inventory and the Life Orientation Test—Revised we analyzed data from the All Our Babies longitudinal prospective pregnancy cohort, based in Calgary, Alberta, Canada. The All Our Babies methodology has been described in detail elsewhere (Gracie et al. 2010; McDonald et al. 2013). The All Our Babies study was initiated in 2008, and was created with the intention of examining maternal and infant outcomes in both the prenatal and postnatal periods. One of the many study objectives is to study maternal mental health throughout pregnancy and to examine the long-term impacts on maternal wellbeing as well as child health and development.

## Ethical Approval

This study has been granted ethical approval by the following ethics review boards: the Child Health Research Office and the Conjoint Health Research Ethics boards of the Faculties of Medicine, Nursing and Kinesiology of the

University of Calgary. Consent was obtained at the time of recruitment, and copies of consent forms are maintained.

## Recruitment

Women were recruited for the All Our Babies study from several sources, including primary and prenatal care offices, Calgary Laboratory Services (the single provider public health laboratory services), posters and word of mouth. Women were considered eligible for participation if they met the following criteria: at the time of recruitment, they could not be more than 24 weeks and 6 days gestation, fluent in English and sufficiently literate to read and complete and questionnaires. English fluency and literacy was determined at recruitment by face to face interview and self report. Over the 3-year process, eight women were considered ineligible for their lack of English fluency. In total 4003 women were initially recruited for the study, and 3300 women completed all three questionnaires in the initial study.

## Questionnaires

For the initial study, participants were mailed questionnaires at two time points during pregnancy and once again at 4 months post partum. The first questionnaire was completed prior to 25 weeks gestation, and the second was completed between 32 and 36 weeks gestation. All three questionnaires gathered data regarding demographics, general health, life style and health and community resource utilization. In addition, each questionnaire contained several standardized tools intended to measure psychosocial outcomes such as depression, stress and anxiety. Following the initial data collection, follow up studies have been carried out at 4, 12 and 24 months post partum, with further follow ups at 36 months and 5 years currently in progress. Many of the same standardized tools were used in the data collection at follow ups, with the addition of age appropriate child development scales.

## Target Measures

For the purposes of this study, the internal consistency and reliability of the following scales were measured; the Spielberger State Anxiety scale (Spielberger and Gorsuch 1970), The Perceived Stress Index (Cohen et al. 1983) and the Life Orientation Test—Revised (Scheier and Carver 1985). Depression was evaluated as a related construct using the Edinburgh Post-Natal Depression scale (Cox et al. 1987).

(i) The Spielberger State Anxiety Scale is a subscale of the State-Trait Anxiety Inventory (Spielberger and Gorsuch 1970) and is a 20 item scale intended to measure an individual's current state of anxiety, as opposed to a personal

characteristic or 'trait'. State anxiety can often be associated with a particular event, and may be transient or indicative of changing mental health status (see Table 1).

The initial validation study for the state—anxiety scale was on a group of high school and university students in Australia in 1975 (Gaudry et al. 1975). The initial values were strong, with good internal consistency. The Cronbach's alpha's for the state anxiety scale were reported to be between 0.83 and 0.94. Test retest coefficients for the state anxiety scale varied from 0.16 to 0.54. The authors indicated that the low test retest scores were a function of the design of the scale, as the state anxiety was designed to capture transient anxiety, and was not expected to be have long term stability. State anxiety was also found by the authors to correlate highly with stress, as opposed to the trait anxiety subscale which did not vary with stressful and non stressful testing conditions. Subsequent validation studies for this inventory have reported Cronbach's alphas of 0.83 to 0.95 with 1 week test retests ranging between  $r = 0.57$  and  $r = 0.68$  (Abdel-Khalek 1989; van der Bij et al. 2003; Dennis et al. 2013). The State Anxiety subscale has been further validated in a pregnant population in Australia, yielding a cronbach's alpha of 0.95 (Grant et al. 2008).

(ii) The Perceived Stress Index is a measure of global stress, which was defined by the authors as the degree to which individuals experience stress in their daily lives (Cohen et al. 1983). This measure was designed to assess stress without asking for individual assessments or perceptions of previous life history or associations with particular events. This scale was therefore deemed appropriate for use in pregnancy as it will capture heightened stress levels that commonly occur during pregnancy without association to individual events. The ten item scale was used in this study (see Table 2).

The original validation study was conducted on groups of university students and individuals participating in a smoking cessation program. The internal consistency was high for all groups, with Cronbach's alphas reported from 0.84 to 0.86. Test retest correlations declined with time, from 0.85 at 1 week to 0.55 at 6 weeks. Subsequent validation studies of the Perceived Stress Index have reported Cronbach's alphas ranging from 0.78 to 0.84 (Cohen et al. 1983; Roberti et al. 2006; Nordin and Nordin 2013). An Arabic version of the 10 item perceived stress index was validated in a sample of 268 women consisting of pregnant and postpartum women as well as a control sample of female university students (Chaaya et al. 2010). The author found that among postpartum women, the Arabic version of the scale had an overall Cronbach's alpha of 0.71. In addition, the authors examined correlations with using depression the Edinburgh Postnatal Depression Scale. The Spearman's Correlation Coefficients for pregnancy and

**Table 1** Scales and their time points

	Up to 25 weeks	32–36 weeks	4 months postpartum	12 months postpartum	24 months postpartum
Spielberger State Anxiety Scale	X	X	X	X	X
Perceived Stress Index	X	X	X	X	
Life Orientation Test Revised		X			

**Table 2** Characteristics of the AOB Participants

Characteristic	N (%)
Maternal age at delivery (n = 2670)	
Age—less than 25	153 (5.7)
Age—25 to 34	1872 (70.1)
Age—35 and above	645 (24.1)
Marital status (n = 3354)	
Married/common law	3165 (94.4)
Single/separated/divorced/widowed	189 (5.6)
Education (n = 3356)	
High school or less	370 (11)
Some post secondary and above	2986 (88.9)
Ethnicity (n = 3354)	
Caucasian	2636 (78.6)
Non-Caucasian	718 (21.4)
Combined Household Income (n = 3252)	
Less than \$40,000	299 (9.2)
\$40,000–\$79,000	717 (21.4)
\$80,000 and greater	2236 (68.8)
Born in Canada (n = 3360)	
Yes	2623 (78.1)
No	737 (21.9)
Major depression (EPDS $\geq$ 13)	
Prenatal (n = 3384)	405 (12)
4 months postpartum (n = 3041)	152 (5)
State Anxiety (STAI $\geq$ 40)	
Prenatal (n = 3363)	924 (27.5)
4 months postpartum	440 (15)
Perceived stress (1 standard deviation above the mean)	
Prenatal (n = 3376)	1041 (30.8)
4 months postpartum	714 (23.8)
Life Optimism Test Revised (n = 2925)	
Low optimism (20th percentile)	582 (19.9)
High optimism	2343 (80.1)

\* Source: McDonald et al. (2014)

postpartum were 0.45 and 0.56 respectively and were significant at  $p < 0.05$ .

(iii) The Life Orientation Test—Revised was developed in 1984 by Scheier and Carver (1985), with the intention of assessing the extent to which individuals form optimistic or pessimistic expectations of future outcomes. The scale was intended to measure both stable personality traits and

generalized outcome expectations, described by the authors as an optimistic outlook that is not specifically ascribed to one particular cause. The authors theorized that having generalized optimistic outcome expectancy would have implications for health, as optimistic individuals would both perceive their health to be better and to engage more frequently in health promoting behaviours (see Table 1).

Scheier and Carver (1985) validated their scale on a population of university students in 1985. They reported the scale as having good internal consistency, with a Cronbach's alpha of .76. The scale was revised in 1994, and subsequent validation studies have reported Cronbach's alphas of 0.61 to 0.81 (Rini et al. 1999; Lai and Yue 2000; Herzberg et al. 2006). The scale was further validated in a Spanish speaking pregnant population, yielding a Cronbach's alpha of 0.81 (Rini et al. 1999).

#### Data Analysis: Reliability and Validation Measures

Reliability for all scales was calculated by testing the internal consistency of each scale using Cronbach's alpha. As a measure of reliability, the Cronbach's alpha is intended to measure the extent to which all items in the scale are related (Cronbach 1951). As a result, Cronbach's alpha is a useful measure to assess if items in a scale are measuring the same construct (Cronbach 1951; Tavakol and Dennick 2011). Cronbach's alphas were calculated for all time points where data was available, and compared to assess stability.

Further reliability measures were calculated by performing test retests between the first and second data points. Test retests are performed to assess the stability of the scale over time, with the assumption that the conditions will not have changed between test periods (Guttman 1945). Test retest measures are highly susceptible to bias; if the time between tests is great, the possibility of confounding factors in the intervening period increases. As the time lapse between the first and second data points used in this analysis is significant, care was taken in interpreting the results.

Validation measures were calculated for the State Anxiety Inventory and the Perceived Stress Index by calculating Pearson Correlation Coefficients with closely related constructs. To that end, Pearson Correlation Coefficients for both the State Anxiety scale and the Perceived stress scale were calculated with each other and with depression, using the Edinburgh Post-Natal Depression Scale.

## Results

### Characteristics of the All Our Babies Study Participants

Overall, the study population is highly characteristic of women having children in Calgary, Alberta (McDonald et al. 2013). The majority of the women in the study were between the ages of 25–34 (70 %), and 95 % were either married or common law. Most women had completed at least some post secondary education (89 %) and had a combined household income of \$80,000 or greater (69 %). 79 % of the study participants identified as Caucasian and 78 % indicated that they were born in Canada. Approximately half of the women in the study gave birth to their first child during the course of the initial study and 27 % had previously experienced pregnancy loss (see Table 2).

### Psychosocial Characteristics of the All Our Babies Study Participants

Psychosocial distress in pregnancy and postpartum was operationalized as scoring as highly symptomatic according to the standardized tools used. Excessive symptomology was operationalized as either high or low depending on the construct. Overall, the period prevalence of women experiencing high anxiety, stress and depression was consistent with provincial and national averages (McDonald et al. 2014). During pregnancy, 12 % of the women had symptoms of major depression (defined as a score of at or above 13 on the Edinburgh Postnatal Depression Scale). 28 % of women reported significant anxiety during their pregnancy, which was operationalized as a score at or above 40 on the State Anxiety Index. Stress was also high during pregnancy, with 31 % reporting excessive perceived stress (defined as above 1 standard deviation above the mean). Overall, psychosocial distress decreased in the postpartum period, with 5 % of women reporting major depression, and 15 and 24 % reporting anxiety and stress respectively.

### Internal Consistency and Reliability

The State Anxiety subscale was measured at all time points. The Cronbach's Alphas were 0.92, 0.92 and 0.93 for 24–26 weeks, 34–36 weeks and 4 months postpartum respectively. At the 12 month follow up, the Cronbach's alpha was 0.93, and 0.92 at the 24 month follow up. The Pearson Correlation Coefficient with depression was as follows:  $r = 0.73$ ,  $r = 0.72$  and  $r = 0.77$  for 24–26 weeks, 34–36 weeks and 4 months postpartum respectively. The Pearson Correlation Coefficients with the Perceived Stress

index for the same time points were  $r = 0.75$ ,  $r = 0.75$  and  $r = 0.77$  respectively. A test retest between times one and two, which on average occurred between 8 and 10 weeks apart, yielded a Pearson's Correlation Coefficient of  $r = 0.60$ . Test retests were not performed between the other time points (see Table 3).

The Perceived Stress Index was measured at all three time points in the original study and again at the 12 month follow up. The Cronbach's alphas were 0.88, 0.88 and 0.89 for 24–26 weeks, 34–36 weeks and 4 months postpartum respectively. The Cronbach's alpha for the 12 month follow up was 0.88. The Pearson Correlation Coefficient with depression was as follows:  $r = 0.75$ ,  $r = 0.75$  and  $r = 0.73$  for the first three time points respectively. The correlation coefficient with depression at the 12 month follow up was 0.76. The test retest between times one and two (24–26 weeks and 34–36 weeks gestation) yielded a Correlation Coefficient of  $r = 0.64$  (see Table 4).

The Life Optimism Test Revised was only measured in the third trimester and yielded a Cronbach's alpha of 0.83.

## Discussion

It is common practice among both researchers and health care professionals to implement tools for the assessment and identification of mental health symptoms in populations on which they were not validated; however, it is important to examine the psychometric properties of such tools in order to have confidence that the results are both valid and reliable. Collection of this information is important for population health to answer research questions of public health importance and many of these tools are common early identification tools, or screening tools, used by health care professionals. Currently, the Edinburgh Postnatal Depression Scale is a widely used tool for early identification of post partum depression; however, maternal distress during pregnancy and in the postpartum period comprises more than depression symptoms alone. There is a growing body of evidence to suggest that anxiety and stress are prevalent during the perinatal period, with implications for maternal and child health outcomes in both the short and long term (Stuart et al. 1998; Matthey et al. 2003; Ross et al. 2003). Furthermore, validated psychosocial tools are vital to the success of many health intervention studies. In a study of smoking patterns amongst pregnant and postpartum women, Pickett et al. (2009) found that withholding psychosocial factors as potential modifiers may result in an overestimation of risk, particularly when causal pathways are not clear. Resiliency is also important to assess during pregnancy and the postpartum. Studies assessing risk are also vulnerable to overestimation if resiliency is not also analyzed as a potential modifier. Dispositional optimism is

**Table 3** State Anxiety subscale

	Cronbach's alpha	Correlation with depression (EPDS)	Correlation with stress
24–26 weeks	0.92	r = 0.73	r = 0.75
34–36 weeks	0.92	r = 0.72	r = 0.75
4 months postpartum	0.93	r = 0.77	r = 0.77
12 month follow up	0.93	r = 0.76	r = 0.71
24 month follow up	0.92	r = 0.71	

**Table 4** Perceived Stress Index

	Cronbach's alpha	Correlation with depression (EPDS)	Correlation with stress
24–26 weeks	0.88	r = 0.75	r = 0.75
34–36 weeks	0.88	r = 0.75	r = 0.75
4 months postpartum	0.89	r = 0.73	r = 0.77
12 month follow up	0.88	r = 0.76	r = 0.71

considered a reasonable proxy for resiliency as it has indications for internal coping mechanisms and self regulation. Furthermore, dispositional optimism is considered moderately intransient, and should therefore have buffering effects that persist through time.

Our analysis suggests that the psychometric properties for all three scales were strong, with Cronbach's alphas that were comparable or higher than literature values. These data provide evidence that the use of these scales, previously validated in other populations, are appropriate for use among pregnant and parenting women at risk for mental distress. As the study population was representative of women having children in Calgary, this study can be generalized to other similar urban populations. However, given that the study population was predominantly Caucasian and of higher socioeconomic status, the results of our study may not be as generalizable to non-English speaking communities and predominately vulnerable populations. Furthermore, the self-report nature of our study is vulnerable to reporting bias, and sensitive constructs may be under-reported. However, where possible, questionnaire data has been correlated with Health Record and administrative data. In addition, given that our reported prevalence of mental distress is in line with other Canadian studies, we are confident in our results.

## Conclusion

The use of standardized tools in public health and population health research is important; it enables comparison across populations and between time points. The results of this study suggest that these three tools can be used with confidence in pregnant and parenting populations and may be useful in identifying a constellation of risk factors that can affect new mothers. Given that the literature on the

Edinburgh Postpartum Depression Scale is extensive and robust (Cox et al. 1987), our conclusion is that the three tools examined in this study should be used in conjunction with the Edinburgh Postpartum Depression Scale, with equal confidence, and that future research should examine the co-occurrence of all four constructs with respect to developing women centered care programs and understanding the complex needs of new and pregnant mothers. As the study population was representative of women having children in Calgary, this study can be generalized to other similar urban populations.

## Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest.

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