

1           **Stress, depressive symptoms, and maternal self-efficacy in first-time mothers:**  
2           **Modeling and predicting change across the first six months of motherhood**

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1                   **Stress, depressive symptoms, and maternal self-efficacy in first-time mothers:**  
2                   **Modeling and predicting change across the first six months of motherhood**

3   **Abstract**

4   **Background:** First-time mothers commonly experience stress and depressive symptoms in the  
5 postpartum period. Maternal self-efficacy has been shown to be an important protective factor  
6 against these experiences; however, research on the dynamic nature of stress, depressive symptoms,  
7 and maternal self-efficacy is limited. The aim of this study was to document changes in these  
8 psychological factors among first-time mothers, and determine how early maternal self-efficacy  
9 perceptions may predict change in stress and depressive symptoms over the first six months  
10 postpartum. **Methods:** Sixty first-time Australian mothers were recruited during their third  
11 trimester of pregnancy. Participants completed a baseline survey during third trimester of pregnancy  
12 ( $M = 32.87$  weeks,  $SD = 2.62$  weeks), and subsequently reported stress, depressive symptoms, and  
13 maternal self-efficacy every three weeks postpartum for six months. Latent growth curve modelling  
14 was used to estimate participants' change over time for stress and depressive symptoms. **Results:**  
15 First-time mothers' stress and depressive symptoms peaked, and maternal self-efficacy was weakest,  
16 at 3-weeks postpartum. Maternal self-efficacy at 3-weeks postpartum was a significant (negative)  
17 predictor of 3-week levels of, and also (positively) predicted later reductions in, stress. **Conclusion:**  
18 Future interventions aimed at bolstering early maternal self-efficacy may protect against postpartum  
19 stress for first-time mothers.

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23 **Key Words:** anxiety; maternal health; psychological distress; mental health; community health  
24

## Introduction

Many women find it difficult to manage the physical, social, and psychological challenges that accompany early motherhood (Kunseler, Willeman, Oosterman, & Schuengel, 2014; Mercer, 2004), and nearly half of women report experiencing stressful life events or social health problems (e.g., financial difficulty, serious family conflict) in the six months following childbirth (Yelland, Sutherland, & Brown, 2010). These issues are particularly prominent for first-time mothers, who are more likely to experience stress and depressive symptoms than multiparous mothers (Australian Institute of Health and Welfare, 2012; Leahy-Warren & McCarthy, 2011). Aside from these health issues for first-time mothers, maternal maladjustment problems in the postpartum period can also lead to a complex series of issues in entire family units (Fahey & Shenassa, 2013). High levels of stress and depressive symptoms in the postpartum period have been associated, for example, with poorer cognitive, behavioural, and emotional adjustment for the child (e.g., Kingston, Tough, & Whitfield, 2012; Letourneau et al., 2012), and can also have a negative influence on relationships with other family members (e.g., Meighan, Davis, Thomas, & Droppleman, 1999). There is a need, therefore, for research effort to be directed toward assisting first-time mothers with their postpartum mental health.

In light of the significant implications of maternal mental health (for mothers and others), and in order to identify appropriate intervention strategies to assist mothers in the early postpartum period, research attention has been directed toward understanding the contributors to, and protectors against, maternal stress and depressive symptoms. In a review of this literature, Emmanuel and St John (2010) outlined a range of personal (e.g., mothers' age, parity, educational level) and interpersonal (e.g., social support, relationship with partner) factors commonly associated with maternal stress and depressive symptoms. More recently, researchers investigating mothers' postpartum experiences have also reported that a sense of loss and frustration, troublesome family relationships, baby management, and expectations of motherhood are common concerns among mothers, and often contribute to their experiences of distress (Bilszta, Ericksen, Buist, & Milgrom,

1 2010; Edhborg, Nasreen, & Kabir, 2015; Hight, Stevenson, Purtell, & Coo, 2014; Law, Jackson,  
2 Guelfi, Nguyen, & Dimmock, 2018).

3         One psychological factor that has been frequently identified as a protector against stress and  
4 depressive symptoms is maternal self-efficacy (e.g., Leahy-Warren, McCarthy, & Corcoran, 2012).  
5 Self-efficacy beliefs represent an individual's confidence in their ability within a given setting or  
6 context (Bandura, 1997). Weak maternal self-efficacy beliefs have been found to be associated with  
7 increased feelings of anxiety, depression, and stress (e.g., Bloomfield & Kendall, 2012; Leahy-  
8 Warren & McCarthy, 2011), whereas strong maternal self-efficacy perceptions appear to be  
9 associated with lower parenting stress (e.g., Liu, Chen, Yeh, & Hsieh, 2012). Maternal self-efficacy  
10 has also been found to positively predict a range of other outcomes, including parenting behaviours  
11 (e.g., Coleman & Karraker, 2003), children's self-efficacy, and children's academic success (e.g.,  
12 Ardel & Eccles, 2001; Leerkes & Burney, 2007). In addition, maternal self-efficacy has been  
13 identified as a moderator of mothers' prenatal stress and infants' crying behaviour; specifically,  
14 infants of mothers who reported high levels of prenatal stress cried less when their mother had  
15 strong (compared to weak) maternal self-efficacy beliefs (Bolten, Fink, & Stadler, 2012). In sum, a  
16 relatively well-developed body of research evidence indicates that a strong sense of confidence in  
17 one's maternal capabilities protects against mothers' stress and depressive symptoms in the  
18 postpartum period, and promotes more adaptive parenting behaviour and outcomes for the child.

19         Maternal self-efficacy has often been operationalised with respect to mothers' confidence in  
20 their ability to perform tasks associated with caring for their baby (e.g., "I can soothe my baby  
21 when he/she is distressed"), or in relation to more holistic perceptions about being a mother (e.g.,  
22 "being a parent is manageable"; see Crncec, Barnett, & Matthey, 2010, for a review). Clearly, tasks  
23 associated with caring for one's baby are a critically important tasks associated with motherhood;  
24 there are, however, additional specific behavioural and situational demands that might contribute to  
25 a first-time mother's overall self-efficacy. For example, mothers from zero to six weeks postpartum  
26 have previously highlighted challenges with respect to managing their family relationships (Lugina,

1 Christensson, Massawe, Nystrom, & Lindmark, 2001). It has also been documented that a  
2 successful transition to motherhood requires the ability to negotiate changes in the relationship with  
3 one's partner (e.g., Darvill, Skirton, & Farrand, 2010), and to regulate various non-baby-related  
4 behaviours, such as self-care (e.g., getting sufficient sleep) and household commitments (e.g.,  
5 chores) (e.g., Barkin & Wisner, 2013; McVeigh, 1997). Consistent with Bandura's (2006)  
6 recommendations that efficacy assessments include important task-related, behavioural, and  
7 cognitive demands, we sought to measure maternal self-efficacy in this study with respect to baby-  
8 related factors, mothers' interpersonal relationships, and self-regulatory behaviours. Accordingly, in  
9 this present study, we adopted a broad conceptualisation of maternal self-efficacy, reflecting  
10 mothers' confidence in their ability regarding the tasks, self-regulatory skills/behaviours, and  
11 relationship management factors associated with the transition to motherhood.

12         A comprehensive understanding of the nature, antecedents, and consequences of maternal  
13 self-efficacy is paramount if intervention efforts to improve mothers' confidence are to be  
14 appropriately timed and designed. Indeed, other researchers have suggested a need for greater  
15 investigation of maternal self-efficacy using longitudinal designs (Kunseler et al., 2014). Such  
16 approaches would allow for insight into within- and between-person variation in this construct, and  
17 the temporal relations between maternal self-efficacy and relevant correlates (e.g., indicators of  
18 psychological distress). In order to deepen our understanding of the changes and adaptations that  
19 take place during the early postpartum period, it has been highlighted that a particularly important  
20 objective of longitudinal work in this area should be to investigate—in as much detail as is possible  
21 without overburdening mothers—the associations between stress, depressive symptoms, and  
22 maternal self-efficacy at multiple points across the early postpartum period (Kunseler et al., 2014).  
23 To date, however, only a limited number of longitudinal studies have been conducted with the aim  
24 of documenting change in perceived stress, depressive symptoms, and/or anxiety from pregnancy to  
25 postpartum. These studies have typically focused either on depressive symptoms alone (e.g., Abbasi,  
26 van den Akker, & Bewley, 2014; Bowen, Bowen, Butt, Rahman, & Muhajarine, 2012), on the

1 period of pregnancy alone (e.g., Parcells, 2010), or on a relatively short period postpartum (e.g., one  
2 month; Britton, 2008). There are even fewer examples in the literature whereby investigators have  
3 documented changes in maternal self-efficacy during the postpartum period, or modelled the  
4 relations between early maternal self-efficacy (e.g., during pregnancy or in the early postpartum  
5 period) and changes in, or initial levels of, stress and depressive symptoms (Kunseler et al., 2014).

6         Understanding early postpartum changes in maternal self-efficacy is important, but  
7 obtaining a more detailed account of the predictive nature of maternal self-efficacy perceptions  
8 following childbirth (on subsequent stress and depressive symptoms) is also necessary. Self-  
9 efficacy beliefs at a given time point have been shown, in other domains, to have both short- and  
10 longer-term protective effects on various outcomes. For example, strong self-efficacy beliefs have  
11 been found to predict *later* intention to engage in physical activity (e.g., Hamilton, Warner, &  
12 Schwarzer, 2017), lower depressive symptoms (Steca et al., 2014), and better outcomes from  
13 substance abuse treatments (see Kadden & Litt, 2011). It is possible, therefore, that the self-efficacy  
14 beliefs formed in the early postpartum period may be responsible for shaping how important  
15 outcomes (e.g., stress, depressive symptoms) change over time. It is well documented that first-time  
16 mothers experience mental health challenges in the form of (the potential for) significant stress and  
17 depressive symptoms during the first six months of pregnancy (e.g., Kunseler et al., 2014; Law et  
18 al., 2018). Thus, studying early postpartum maternal self-efficacy—with an emphasis on informing  
19 intervention design—could help researchers to better understand how to encourage more favourable  
20 outcomes for first-time mothers (i.e., lower postpartum stress and depressive symptoms).

21         Attempts to promote maternal self-efficacy as early as possible (e.g., pre-birth) may be  
22 valuable; however, expectant mothers' self-efficacy beliefs during pregnancy may not be a wholly  
23 accurate predictor of postpartum stress and depressive symptoms. Bandura (1997) indicated that in  
24 order for self-efficacy beliefs to engender adaptive functional effects, respondents must be able to  
25 *accurately* appraise their capabilities at that moment in time (i.e., Bandura emphasised the  
26 importance of present-state, “can do” appraisals, rather than intended future-state, or “will do”

1 appraisals). In the case of new mothers, therefore, it is possible that maternal self-efficacy beliefs  
2 formed during pregnancy may not be wholly accurate predictors of postpartum functioning, given  
3 that mothers have not yet faced the various challenges that accompany motherhood. For that reason,  
4 maternal self-efficacy beliefs in the early postpartum period may be a better predictor of stress and  
5 well-being outcomes (when compared to maternal self-efficacy measured in the prenatal period).  
6 Guided by these considerations, in this investigation we sought to determine if early maternal (i.e.,  
7 three week postpartum) self-efficacy scores were predictive of changes in stress and depressive  
8 symptoms across the first six months postpartum.

9         The use of early postpartum maternal self-efficacy as a predictor of change in stress and  
10 depressive symptoms is an extension to our current understanding of the relations between these  
11 constructs. In longitudinal studies in which multiple mental health indices have been measured, the  
12 timing of assessments has often been infrequent enough to identify temporally meaningful  
13 fluctuations in mental health. In a recent study by Kunseler and colleagues (2014), for example,  
14 associations between depression, anxiety, and parenting self-efficacy were examined at 32 weeks of  
15 pregnancy, 3 months postpartum, and 12 months postpartum. Despite such research offering useful  
16 insight into broad trajectories on important mental health constructs, shorter intervals between  
17 assessments may improve sensitivity and enhance researchers' ability to capture variation across  
18 time. Accordingly, in order to advance what is known about maternal self-efficacy and  
19 psychological distress patterns in the postpartum period, it is important for researchers to adopt a  
20 longitudinal design involving intensive assessments by introducing shorter intervals between  
21 measurement points.

22         Using a longitudinal design incorporating a measurement in late pregnancy and regular  
23 measurements (i.e. every three weeks) through the early postpartum period, the aims of this study  
24 were to (a) document changes in stress, depressive symptoms, and maternal self-efficacy among  
25 first-time mothers from late pregnancy to 6-months postpartum, and (b) examine the extent to  
26 which early maternal self-efficacy beliefs predict initial levels of, and change in, stress and

1 depressive symptoms across this time period. In adhering to these aims, we sought to (a)  
2 characterise the fluctuations in our primary variables by examining potential differences over time  
3 in mothers' maternal self-efficacy, stress, and depressive symptoms, and (b) determine the nature of  
4 the associations (i.e., zero-order correlations) at each time point between our variables of interest.  
5 Based on past findings (Leahy-Warren et al., 2012; Yelland et al., 2010), we anticipated that, (a)  
6 stress and depressive symptoms would decline, and maternal self-efficacy would become stronger  
7 with the passing of time postpartum, and (b) maternal self-efficacy would be negatively correlated  
8 with stress and depressive symptoms at all assessment points except in late-pregnancy. In order to  
9 determine the relations between early maternal self-efficacy beliefs and change trajectories for  
10 stress and depressive symptoms, we employed a modelling technique known as latent growth curve  
11 modelling (LGCM; Duncan & Duncan, 2009). LGCM analysis is an increasingly popular statistical  
12 modelling method that enables researchers to examine, and understand the predictors of, change  
13 trajectories. A better understanding of how early maternal self-efficacy predicts stress and  
14 depressive symptoms is important for capturing trends in maternal well-being, and for informing  
15 future intervention efforts aimed at preventing psychological distress among new mothers. Based on  
16 findings reported by Kunseler and colleagues (2014), we hypothesised that stronger maternal self-  
17 efficacy at 3-weeks postpartum would (a) predict lower initial levels (i.e., 3-weeks postpartum), and  
18 (b) a steeper rate of decline (i.e., slope), of postpartum stress and depressive symptoms from 3- to  
19 24-weeks postpartum.

## 20 **Method**

### 21 **Participants**

22 Sixty-eight pregnant women registered for (and began participating in) the study; however,  
23 eight participants dropped out of the study after completing only the baseline survey (i.e., became  
24 non-contactable during the data collection period), and were subsequently excluded from analysis.  
25 The mean age of participants at recruitment was 31.5 years ( $SD = 2.89$ ); all were first-time mothers  
26 who had partners, and reported no health (i.e. physical or mental) or pregnancy complications. Only

1 mothers who scored between 1 and 13 on the Edinburgh Postnatal Depression Scale (EPDS; Cox,  
2 Holden & Sagovsky, 1987) (i.e., experiencing mild or moderate depressive symptoms rather than  
3 major depression) were included as participants in the study. One participant was recommended for  
4 referral at recruitment due to scoring more than 13 on the EPDS scale. Participants were, on  
5 average, 32.5 weeks into their pregnancy at recruitment (i.e., third trimester), and 98% had  
6 completed a high school diploma or higher. All participants were from the Perth metropolitan area,  
7 Western Australia.

## 8 **Procedures**

9 Ethical approval to conduct the study was granted by the lead author's institutional ethics  
10 review board. Participants were recruited via email, word of mouth, and through advertisements at  
11 maternal health centres, yoga studios (that provided prenatal yoga), and doulas. Upon contacting the  
12 lead author, participants were provided with an information sheet outlining the requirements of the  
13 study and their participant rights, before being asked to provide their informed consent to  
14 participate in the study. Participants were subsequently provided (electronically) with a link to the  
15 first survey once they entered their third trimester of pregnancy, in which they reported their age,  
16 stage of pregnancy (i.e., number of weeks pregnant), expected due date, and education level, and  
17 completed assessments of stress, depressive symptoms, and maternal self-efficacy (more  
18 information on psychosocial assessments is presented in the 'Measures' section). One week after  
19 their expected due date, an email was sent to participants to confirm their infant's actual date of  
20 birth. Once the birth date had been established, follow-up emails were sent every three weeks from  
21 that date until 24 weeks postpartum (i.e., at weeks 3, 6, 9, 12, 15, 18, 21, and 24 post-birth). The  
22 surveys that participants completed every 3 weeks included assessments of stress, depressive  
23 symptoms, and maternal self-efficacy.

## 24 **Measures**

25 **Depressive symptoms.** The Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden &  
26 Sagovsky, 1987) is a 10-item instrument developed for use by both pregnant and postpartum

1 women to measure risk of perinatal depression. Example items include “I have been able to laugh  
2 and see the funny side of things”, and “I have felt sad and miserable”. The instrument requires  
3 participants to indicate the response closest to how they have felt in the past seven days; response  
4 labels vary across items, but all range from 0 to 3. Scores are summed (with reverse scored items  
5 corrected) to give a total score. These scores compare the diagnostic criteria for depression with  
6 normative experiences of perinatal women, whereby higher scores indicate greater experience of  
7 depressive symptoms. A score greater than 13 indicates a high likelihood of depression and a  
8 referral is usually recommended. In this study, when any participants reported such scores, the first  
9 author made contact with the participant for an informal ‘check in’ and to recommend that the  
10 participant consider a referral to seek professional help. A referral was only made with participants’  
11 consent. In total, eight women were recommended for referral between 3 and 24 weeks postpartum.  
12 The EPDS has been used in previous perinatal studies and scores derived from the EPDS have  
13 demonstrated evidence of internal consistency (e.g., Meltzer-Brody, Boschloo, Jones, Sullivan, &  
14 Penninx, 2013; Sockol Epperson, & Barber, 2014). Internal consistency estimates ( $\alpha$ ) for EPDS  
15 scores in this study were in the range .82 to .89 ( $M = 0.85$ ,  $SD = 0.03$ ).

16       **Stress.** The Perceived Stress Scale 4 (PSS-4; Cohen & Williamson, 1988) was used to  
17 measure perceptions of stress. The PSS-4 is an abbreviated version of the original 14-item  
18 perceived stress scale (Cohen & Williamson, 1988) that requires participants to indicate how often  
19 they have felt a certain way in the last seven days. Example items include “Felt that you were  
20 unable to control the important things in your life”, and “Difficulties were piling so high that you  
21 could not overcome them”, with a response scale anchored at 1 (*never*) and 5 (*very often*). A total  
22 score was computed by summing all item scores, whereby a higher score indicates higher levels of  
23 stress. Scores from the PSS-4 have previously demonstrated evidence of internal consistency (e.g.,  
24 Karam et al., 2012), and in this study, estimates of internal consistency ( $\alpha$ ) for scores derived from  
25 the PSS-4 ranged from .67 to .82 ( $M = 0.75$ ,  $SD = 0.05$ ).

1           **Maternal self-efficacy.** An instrument designed to measure focal aspects of maternal self-  
2 efficacy was developed specifically for this study. Item content and breadth was developed in line  
3 with guidelines by Bandura’s (2006) recommendations that items cover the range of task-related,  
4 behavioral, and cognitive demands central to the focal domain. This instrument was developed  
5 because existing maternal self-efficacy scales (e.g. Barnes & Adamson-Macedo, 2007; Crncec,  
6 Barnett, & Matthey, 2008) were designed to focus largely on *task-related* (e.g., baby-focused)  
7 behaviours. Bandura (1997) suggested that for behaviours performed regularly (e.g., as part of one’s  
8 daily routine), it may be insufficient to only assess task-related behaviours, and recommended that  
9 the assessment of regulatory behaviours also be included in self-efficacy instruments. As a result,  
10 we sought to include a range of important task and regulatory requirements associated with  
11 effective functioning in early motherhood.

12           To ensure we achieved appropriate item coverage, an open-ended survey was administered to  
13 24 mothers, who were asked to identify capabilities, challenges experienced, and tasks required  
14 during an effective transition into early motherhood. These mothers gave birth between 1985 and  
15 2015, and the mean age when they first became a mother was 30.25 ( $SD = 2.24$ ). Their responses to  
16 the survey were incorporated into item development for the self-efficacy instrument, which was  
17 designed with the aim of assessing a range of aspects relating to the execution of important tasks  
18 (e.g. changing nappies/diapers, feeding), and key self-regulatory (e.g., managing physical and  
19 mental health) and relationship management (e.g. relationship with partner, baby) factors. In line  
20 with Bandura’s (2006) recommendations for the assessment of self-efficacy, participants were  
21 instructed, when responding to all items, to consider their confidence in their capability to carry out  
22 the issue in question at that moment in time. This instrument contained 14 items, including “know  
23 what your baby wants all the time”, and “maintain a close relationship with your partner even when  
24 you have difficulties with your baby” (the final instrument is presented in Table S1). Consistent  
25 with recent self-efficacy research (e.g., Jackson, Compton, Whiddett, Anthony, & Dimmock, 2015),

1 items were scored on a 5-point response scale anchored at 1 (*not confident at all*) and 5 (*extremely*  
2 *confident*).

3 Internal consistency estimates ( $\alpha$ ) for scores derived from this maternal self-efficacy  
4 instrument ranged between .86 and .93 ( $M = 0.90$ ,  $SD = 0.02$ ). A principal components analysis was  
5 also conducted to examine the dimensionality of scores derived from the instrument. Analyses  
6 indicated that all items loaded onto a primary factor (variance explained = 54.04%; eigenvalue =  
7 7.03); the lowest factor loading for any item on this primary factor was .54, which, according to  
8 Comrey and Lee's (1992) recommendations regarding the interpretation of factor loadings, is  
9 considered borderline "good" ( $\geq .55$ ; Comrey & Lee, 1992). Three items had factor loadings of .50  
10 or more on a secondary factor (variance explained = 10.52%; eigenvalue = 1.37). Of these three  
11 items, two had higher loadings on the primary factor. In addition, the three items that loaded onto  
12 this secondary factor did not appear to be conceptually 'coherent' in any meaningful (i.e.,  
13 distinguishable) way. Given that (a) items were designed in line with Bandura's recommendations  
14 to provide an overall (i.e., single factor) measure of maternal agency (and not to measure multiple  
15 different sub-domains), (b) the strength of the factor loadings for all items on the primary factor,  
16 and (c) that there was little conceptual justification or distinguishability associated with the three  
17 items that cross-loaded onto the second factor, a single factor solution was retained (see Fabrigar,  
18 Wegener, MacCallum, & Strahan, 1999; Matsunaga, 2010). Item-level descriptive statistics and  
19 correlations between items at 3-weeks postpartum can be found in the supplementary material (see  
20 Tables S1 & S2).

## 21 **Data Analysis**

22 Data were initially screened for missing values, and univariate and multivariate normality  
23 was examined using IBM SPSS Version 23. Primary analyses were conducted in three stages. First,  
24 one-way repeated measures ANOVAs were used to identify changes over time in stress, depressive  
25 symptoms, and maternal self-efficacy. Second, bivariate correlations were computed to examine (a)  
26 associations between stress, depressive symptoms, and maternal self-efficacy within each time point,

1 and (b) relations between participants' self-efficacy at 3-weeks postpartum and all postpartum  
2 scores on stress and depressive symptoms. Finally, LGCM models were estimated separately for  
3 stress and depressive symptoms, with 3-weeks postpartum maternal self-efficacy specified as a  
4 predictor of initial levels of, and change in, stress and depressive symptoms from 3-weeks to 24-  
5 weeks postpartum. LGCM analysis allows for the modelling of within-person change trajectories  
6 over time in stress and depressive symptoms. Using structural equation modelling, a priori defined  
7 (e.g., linear, quadratic) growth patterns are estimated (Muthen & Khoo, 1998). LGCM can be used  
8 to subsequently determine if predictors explain variation in both intercept and growth trajectories  
9 (Duncan & Duncan, 2009). Interested readers are referred to Duncan and Duncan (2009) for a  
10 conceptual and statistical overview of LGCM models. In preparation for fitting a model with a  
11 predictor, three models (intercept only, linear, and quadratic) without a predictor were compared in  
12 the first instance. In making comparisons between models, Akaike's Information Criterion (AIC)  
13 and Bayesian Information Criteria (BIC) were used, and models with smaller AIC and BIC values  
14 indicate better models. Subsequently, a predictor was added to the best model and model fit was  
15 assessed using the  $\chi^2$  goodness-of-fit index, the comparative fit index (CFI), Tucker-Lewis index  
16 (TLI), and root mean square error of approximation (RMSEA), with evidence of adequate fit  
17 indicated by CFI/TLI  $\geq$ .90 and RMSEA  $\leq$ .08 (Marsh, Hau, & Wen, 2004; Tabachnick & Fidell,  
18 2007). However, it is common for LGCMs to have poor fit based on conventional criteria (Preacher,  
19 2010); therefore, rather than depending on stringent cut-off criteria to interpret fit of the LGCMs, fit  
20 was interpreted based on theory and interpreting values *close* to the guidelines instead. Analyses  
21 were performed using Mplus version 7.4 (Muthen & Muthen, 1998-2015), with a robust maximum  
22 likelihood estimator (MLR) and full information likelihood (FIML) to ensure that all available data  
23 were used to estimate model parameters.

## 24 **Results**

25 Descriptive statistics (i.e., mean, standard deviation) for stress, depressive symptoms, and  
26 maternal self-efficacy at all assessments are displayed in Table 1. For maternal self-efficacy, inter-

1 item correlations indicated that item 2 (“maintain a close relationship with your partner even when  
2 you have difficulties with your baby”) displayed negative correlations with other items at various  
3 time points; this item was subsequently dropped from the scale and excluded from further analyses.

4 [Insert Table 1]

5 The sphericity assumption was violated when conducting all three one-way repeated  
6 measures ANOVAs, and as such, Greenhouse-Geisser adjustments were used. A Sidak correction  
7 was also applied to account for multiple comparisons and reduce familywise error rate. Analyses  
8 revealed a significant time effect for stress,  $F(6.17, 253.01) = 3.60, p = .002, \eta_p^2 = .08$ , depressive  
9 symptoms  $F(5.65, 231.76) = 6.12, p < .001, \eta_p^2 = .13$ , and maternal self-efficacy  $F(5.20, 213.35) =$   
10  $37.34, p = .002, \eta_p^2 = .48$ . Post-hoc comparisons revealed that participants had significantly higher  
11 stress and depressive symptom scores at 3-weeks postpartum than all other assessment points. Mean  
12 differences for stress and depressive symptom scores between assessment points can be found in  
13 Table S3 & S4 respectively. Mean maternal self-efficacy at 3-weeks postpartum was significantly  
14 lower than all subsequent assessment points, but not significantly different to late-pregnancy scores.  
15 Mean differences for maternal self-efficacy scores between assessment points can be found in Table  
16 S5. Taken together, these analyses indicated that stress and depressive symptoms were strongest,  
17 and self-efficacy (close to) weakest at 3-weeks postpartum.

18 Bivariate correlations (see Table 2) between primary variables within each time point  
19 indicated that scores for stress and depressive symptoms consistently displayed significant and  
20 moderate-to-strong positive correlations ( $r = .58$  to  $.81$ ; all  $p < .01$ ) at all assessments. Maternal self-  
21 efficacy displayed significant negative correlations with stress ( $r = -.50$  to  $-.66$ ; all  $p < .01$ ) and  
22 depressive symptoms ( $r = -.48$  to  $-.71$ ; all  $p < .01$ ), except at baseline (late pregnancy) for stress ( $r =$   
23  $-.22, p = .10$ ) and depressive symptoms ( $r = -.15, p = .26$ ). Bivariate correlations for 3-week  
24 postpartum self-efficacy in relation to later stress and depressive symptoms (i.e., from 6- to 24-  
25 weeks postpartum) are displayed in Table 3; significant and moderate-to-strong negative  
26 correlations were observed for stress ( $r = -.32$  to  $-.66$ ; all  $p < .01$ ) and depressive symptoms ( $r = -$

1 .39 to -.71; all  $p < .05$ ) across all time points. That is, when mothers reported stronger self-efficacy  
2 beliefs at 3-weeks postpartum, they reported lower subsequent stress and depressive symptoms  
3 across the entire study period (for comparison purposes, correlations between baseline self-efficacy  
4 and later stress and depressive symptoms are presented in the supplementary material, Table S6).

5 [Insert Table 2 & Table 3]

6 Based on AIC and BIC values, the quadratic model was the best fitting model for stress and  
7 depression in this sample (Table 4). Before the addition of 3-week postpartum self-efficacy as a  
8 predictor, and referring to the suggestion by Hox (2002), the variances of both the intercept and  
9 slope were examined for variability. With the exception of linear and quadratic slope factor for  
10 stress, all other slope and intercept factors had significant variances (Table 5), which suggests that  
11 there are variabilities in growth trajectories in depressive symptoms and stress for the current  
12 sample. Thus, 3-week postpartum self-efficacy was added into the models to explain the variability  
13 in growth trajectories (the syntax used for the analysis is available in Supplementary Material S7) .  
14 The predictor model for depressive symptom scores showed evidence of inadequate fit to the data,  
15  $\chi^2(32) = 62.64, p = .001, CFI = .90, TLI = .89, RMSEA = .13$ ; however, the predictor model for  
16 stress scores showed evidence of acceptable fit  $\chi^2(32) = 49.03, p = .03, CFI = .93, TLI = .92,$   
17  $RMSEA = .10$ . In general, stress decreased from 3- to 24-weeks postpartum (estimated linear mean  
18 slope =  $-0.67, p < .001$ ) and followed a curvilinear pattern (estimated quadratic mean slope =  $0.06,$   
19  $p = .001$ ; Fig 1.). The initial level (i.e., intercept) of stress was significantly (and negatively)  
20 predicted by maternal self-efficacy at 3-weeks ( $B = -2.82, SE = 0.46, p < .001$ ), which indicates that  
21 stronger maternal self-efficacy at 3-weeks postpartum was associated with lower initial stress.  
22 Maternal self-efficacy at 3-weeks postpartum positively predicted the linear slope ( $B = 0.56, SE =$   
23  $0.24, p = .02$ ), but not the quadratic slope of stress ( $B = -0.06, SE = 0.03, p = .05$ ); in other words,  
24 stronger maternal self-efficacy at 3-weeks postpartum predicted a more gradual decrease in stress  
25 from 3-weeks to 24-weeks postpartum. Initial levels of stress were also significantly (and  
26 negatively) related to the linear slope of stress ( $r = -0.60, p < .001$ ), indicating that higher initial

1 levels of stress were associated with a steeper decrease in stress from 3-weeks to 24-weeks  
2 postpartum.

3 [Insert Table 4, Table 5 & Figure 1]

#### 4 **Discussion**

5 The aims of this study were to (a) document changes in stress, depressive symptoms, and  
6 maternal self-efficacy among first-time mothers from late pregnancy to 6-months postpartum, and  
7 (b) determine the relations between early maternal self-efficacy and later stress and depressive  
8 symptoms. Results indicated that, for our sample of first-time mothers, stress and depressive  
9 symptoms peaked at 3-weeks postpartum and followed a decreasing trend soon thereafter. This  
10 peak (at 3-weeks postpartum) may be attributed to difficulties associated with adjusting to the  
11 substantial physical, social, and psychological changes and challenges that commonly occur in the  
12 early postpartum period (Mercer, 2004). One specific contributor to this early postpartum peak in  
13 these variables might be the lack of support from health professionals (e.g. GPs and child health  
14 nurses) until their six week check. Another contributor is that partners (in Australia) often return to  
15 work at this point following two weeks paid leave (Federal Register of Legislation, 2010).  
16 Supporting this explanation, a recent study showed that new mothers' perceptions of social support  
17 are highest in the week postpartum compared to 4-weeks postpartum (Li, Long, Cao, & Cao, 2017),  
18 and social support has previously been found to be negatively associated with stress and depressive  
19 symptoms in the postpartum period (Leahy-Warren et al., 2012). Finally, it is also possible that a  
20 lack of sleep—and difficulties adjusting to sleep disruption—during this period may have  
21 contributed to the observed peak in stress and depressive symptoms; it is well documented, for  
22 example, that poor maternal sleep patterns align with higher levels of stress (e.g., Sinai & Tikotzky,  
23 2012).

24 In general, after the 3-week postpartum assessment (at which point maternal self-efficacy  
25 beliefs were relatively weak), mothers in the present study began to develop greater confidence and  
26 reported reductions in stress and depressive symptoms. In line with Bandura's (1997) writing about

1 mastery achievements and verbal persuasion, it is perhaps unsurprising that mothers' confidence  
2 beliefs were weakest in late pregnancy and the early postpartum period (due to the limited time for  
3 enactive mastery experiences to accrue), and subsequently began to increase as mothers received  
4 positive feedback and developed their repertoire of mothering skills (e.g., learning baby's signs and  
5 body language, managing their time and relationships) (see Haslam, Pakenham, & Smith, 2006). It  
6 is also possible, of course, that the (relatively) high stress and depressive symptoms observed at 3-  
7 weeks postpartum might have also weakened maternal self-efficacy perceptions. Bandura (1997)  
8 outlined that adverse emotional states might compromise individuals' self-efficacy judgments (for  
9 support, see Hoepfner, Kahler, & Gwaltney, 2014), and it is plausible that mothers may have  
10 interpreted the stress and depressive symptoms as a marker that they were not wholly competent at  
11 that point in time. In support of this notion, we also observed that as stress and depressive  
12 symptoms reduced over the course of the study period, this was accompanied by a strengthening of  
13 participants' maternal self-efficacy perceptions. In addition, the lack of significant correlations  
14 between self-efficacy and stress and depressive symptoms during late-pregnancy supports  
15 Bandura's claim that predictive effects of self-efficacy on relevant outcomes will be the weakest  
16 when the rating criteria is ambiguous. This finding is unsurprising as ratings of self-efficacy in late  
17 pregnancy may not be wholly accurate given that, at this point, mothers have not given birth.

18         Latent growth curve analysis revealed evidence of a general decreasing trend in stress across  
19 the course of the study period. What was perhaps most interesting about our correlational and  
20 LGCM analyses, however, was the finding that maternal self-efficacy at 3-weeks postpartum was  
21 associated with lower intercept and slope values for stress. Based on the correlations (see Table 5),  
22 higher maternal self-efficacy at 3-weeks postpartum was related to lower stress and depressive  
23 symptoms later in the postpartum period. In addition, LGCM analysis indicated that maternal self-  
24 efficacy at 3-weeks postpartum significantly predicted lower stress scores at 3-weeks postpartum.  
25 Although LGCM analysis also showed a decreased rate of decline in stress over time, the decreased  
26 decline is most likely due to floor effects.

1           Taken together, the findings in this study highlight the importance of maternal self-efficacy  
2 in the early postpartum period, demonstrating that maternal self-efficacy at 3-weeks postpartum is  
3 negatively related to stress and depressive symptoms, and predictive of changes in stress at later  
4 times. This evidence implies that efforts directed toward improving maternal self-efficacy,  
5 especially in the early postpartum period (or during pregnancy – in preparation for the early  
6 postpartum period), could support positive downstream effects on stress experienced by new  
7 mothers. The pregnancy period has been identified as a teachable moment because mothers might  
8 view their baby’s and their own physical health to be at risk, foresee changes in their social role and  
9 self-concept, and because of their emotional response to the pregnancy (Phelan, 2010). New  
10 mothers might be the most receptive, therefore, to the provision of interventions in the pregnancy  
11 period, and our results indicate that interventions focused on maternal self-efficacy might be  
12 particularly beneficial. Strategies that new mothers perceive to be effective for improving maternal  
13 self-efficacy in the early stages of motherhood have been provided in a recent qualitative study  
14 (Law et al., 2018), and include education for mothers *and* their social support group, clarifying  
15 expectations, and making available structured peer support.

16           The results of this study advance our understanding of stress, depressive symptoms, and  
17 self-efficacy; however, it is important to highlight design limitations. These findings are restricted  
18 to first-time, healthy mothers with a singleton pregnancy, and the extent to which the relationships  
19 observed in the study are similar for mothers with different characteristics and circumstances is  
20 unknown. Also, although all participants reported having partners, the precise live-in situations (e.g.,  
21 domestic helpers, family members) of the participants were not assessed. We cannot know,  
22 therefore, whether differences may exist between mothers who have live-in support versus those  
23 who do not. We also did not assess the type of delivery (i.e. natural or caesarian section) or whether  
24 mothers in our study experienced delivery complications. It is possible that these factors may  
25 contribute to stress and depressive symptoms (e.g., Sarah, Forozan, & Leila, 2017) and we  
26 encourage the assessment of these variables in future studies. In addition, although significant

1 correlations were found between early maternal self-efficacy and postpartum depression, LGCM  
2 analysis for depression did not yield a good fit.

3         It is also important to note that in devising our study, we did consider potential alternative  
4 approaches that may have offered different insight into the process under investigation (e.g. latent  
5 change analysis). Ultimately though, for the model-based part of our analyses, we were most  
6 interested in examining the way in which ‘early’ maternal self-efficacy predicted intercept and  
7 slope in those psychological ‘outcomes’. For that reason, LGCM was chosen as the method of  
8 analysis in this study. Future studies can adopt other potential alternative analytic approaches that  
9 may complement findings from this study. On the issue of modelling and analyses for repeated  
10 measures studies of this kind, there appear to be no widely accepted rules of thumb for sample size.  
11 For example, some researchers have argued that a sample size of at least 100 is optimal for fitting  
12 structural equation models (e.g., Boomsma, 1982); however, others contend that the total number of  
13 person-by-time observations is a more important consideration (e.g., Curran, Obeidat, & Losardo,  
14 2010). That being the case, although we fell short of the ‘100 participants’ recommendation, our  
15 relatively high number of measurement points per participant may have resulted in the sample size  
16 being sufficient (or close to sufficient). In that respect, we took confidence from the fact that the  
17 models we estimated were able to run (and in some cases, demonstrate adequate model fit). All that  
18 said, we do acknowledge that the sample size, at the person level, may be considered modest.

19         Nonetheless, despite these limitations, this study offers important insight into maternal  
20 experiences in the postpartum period, provides preliminary evidence to support a novel  
21 measurement approach for maternal self-efficacy, and highlights the predictive effects of maternal  
22 self-efficacy at 3-weeks postpartum on maternal stress (as well as correlations with depressive  
23 symptoms). In order to help first-time mothers better cope in the postpartum period, and to  
24 potentially engender additional positive effects for family units and children, future intervention  
25 efforts should be targeted at bolstering first-time mothers’ postpartum self-efficacy.

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**Table 1.** Changes in stress, depressive symptoms and maternal self-efficacy from late pregnancy to 6 months post-partum in primiparous women (Mean and standard deviations; n = 60)

Time point	Stress		Depressive symptoms		Maternal self-efficacy	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Late pregnancy	7.19	2.33	5.17	3.46	3.02	0.44
3-weeks postpartum	8.79	2.88	7.17	4.28	3.15	0.64
6-weeks postpartum	7.48	2.47	5.76	4.16	3.52	0.46
9-weeks postpartum	7.71	2.65	5.19	3.88	3.63	0.41
12-weeks postpartum	7.00	2.33	4.04	3.81	3.76	0.48
15-weeks postpartum	7.31	2.47	4.36	3.67	3.80	0.49
18-weeks postpartum	7.17	2.47	4.38	3.77	3.82	0.53
21-weeks postpartum	7.55	2.50	4.83	4.13	3.78	0.56
24-weeks postpartum	7.00	2.08	3.71	3.33	3.81	0.49

*Note.* Stress scores can range from 4 to 20, where higher scores indicate greater stress. Depressive symptoms scores can range from 0 to 30, where higher scores indicate greater risk of perinatal depression. Maternal self-efficacy scores can range from 1 to 5, where higher scores indicate greater confidence.

**Table 2.** Bivariate correlations between stress, depressive symptoms, and maternal self-efficacy at different time points in primiparous women (n = 60).

		Depressive symptoms	Maternal self-efficacy
Late pregnancy	Stress	.67**	-.22
	Depressive symptoms	-	-.15
3-weeks postpartum	Stress	.78**	-.66**
	Depressive symptoms	-	-.71**
6-weeks postpartum	Stress	.58**	-.50**
	Depressive symptoms	-	-.48**
9-weeks postpartum	Stress	.75**	-.65**
	Depressive symptoms	-	-.65**
12-weeks postpartum	Stress	.81**	-.58**
	Depressive symptoms	-	-.60**
15-weeks postpartum	Stress	.77**	-.59**
	Depressive symptoms	-	-.59**
18-weeks postpartum	Stress	.77**	-.57**
	Depressive symptoms	-	-.68**
21-weeks postpartum	Stress	.74**	-.55**
	Depressive symptoms	-	-.69**
24-weeks postpartum	Stress	.63**	-.65**
	Depressive symptoms	-	-.58**

Note. Significant correlation \* =  $p < .05$ , \*\* =  $p < .01$

**Table 3.** Bivariate correlations between 3-week postpartum maternal self-efficacy and later stress and depressive symptoms in primiparous women (n = 60).

3-week Maternal Self-Efficacy		
3-weeks postpartum	Depressive symptoms	-.71**
	Stress	-.66**
6-weeks postpartum	Depressive symptoms	-.51**
	Stress	-.44**
9-weeks postpartum	Depressive symptoms	-.57**
	Stress	-.47**
12-weeks postpartum	Depressive symptoms	-.42**
	Stress	-.38**
15-weeks postpartum	Depressive symptoms	-.39*
	Stress	-.32**
18-weeks postpartum	Depressive symptoms	-.53**
	Stress	-.44**
21-weeks postpartum	Depressive symptoms	-.46**
	Stress	-.44**
24-weeks postpartum	Depressive symptoms	-.52**
	Stress	-.44**

Note. Significant correlation \* =  $p < .05$ , \*\* =  $p < .01$

**Table 4.** Baseline Growth Curve Models for Depression and Stress

	Growth Curve	Goodness-Of-Fit	
		AIC	BIC
Depression	Intercept	2346.32	2367.27
	Linear	2313.73	2340.95
	Quadratic	2301.56	2337.17
Stress	Intercept	2018.44	2039.38
	Linear	2000.11	2027.34
	Quadratic	1993.88	2029.48

Note. Lower AIC and BIC values indicate better models.

**Table 5.** Means and Variances of Study Variables Based on Quadratic Model

	Depression	Stress
Mean Intercept	6.66*	8.57*
Mean Linear Slope	-1.04*	-0.63*
Mean Quadratic Slope	0.09*	0.06*
Intercept Variance	12.63*	5.89*
Linear Slope Variance	1.12*	0.66
Quadratic Slope Variance	0.02*	0.01

Note. \* indicates  $p < .05$