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Predicting posttraumatic stress and depression symptoms among adolescents in the extended postpartum period

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Abstract

Background: Adolescent childbirth continues as a public health concern, and investigation of postpartum posttraumatic stress symptoms (PTSS) and depression is important to inform future research and practice. Longitudinal studies exploring PTSS alone or in combination with depression are non-existent for postpartum adolescent populations. This study aimed to identify stress/PTSS and depression symptoms at 72 hours and three, six, and nine months postpartum, and determine if symptoms at each time point predicted later symptoms.

Methods: A convenience sample of 303 adolescents 13−19 years of age were recruited from two postpartum units of one, large, public hospital. The Impact of Event Scale and the Edinburgh Postpartum Depression Inventory provided a screen of symptoms for stress/PTSS and depression at all time points. A lagged autoregressive model was developed to assess the predictive power of symptoms at each time point to the next across the extended postpartum period.

Results: About 30% of adolescents displayed early symptoms; 20% showed symptoms at the final time point. Early symptoms did not predict symptoms at 3 months; yet, symptoms at 3 months predicted symptoms at 6−9 months.

Limitations: Attrition at final time points necessitated pooled data. Adolescents were primarily older, Hispanics, and recruited from one public hospital

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decreasing demographic representation. Use of screening tools prevented diagnostic outcomes. Unknown stressors occurring before and after pregnancy or birth may have influenced final outcomes.

Conclusions: Early symptoms were common and 3 month symptoms predicted later symptoms. For at risk adolescents, a plan for follow-up beyond hospital discharge is recommended.

Keyword: Psychiatry

1. Introduction

Adolescent childbirth continues to be a common occurrence in the United States (Ruedinger and Cox, 2012). Moreover, a secondary analysis of World Health Organizational (WHO) data revealed that adolescent mothers ages 10 to 19 showed higher risks for maternal and infant complications than mothers ages 20 to 24 (Ganchimeg et al., 2014). Risk factors complicating adolescent births at a higher frequency than adult births, such as preterm birth or neonatal death, limited support, unplanned pregnancy, delayed or limited prenatal care, and violence exposure have been associated with the development of PTSD and/or depression among childbearing adults (Andersen et al., 2012; Kim et al., 2015; Meltzer-Brody et al., 2013; National Institute of Mental Health (NIMH), 2015; Papri et al., 2016; Siegel and Brandon, 2014).

Prevalence of postpartum PTSD specifically among adolescents is unknown; for adult populations about one-third of women perceive their birth as traumatic (Dikmen-Yildiz et al., 2017b), and between1% and 6.3% experience postpartum PTSD (Andersen et al., 2012; Ayers et al., 2016; Dekel et al., 2017; Dikmen-Yildiz et al., 2017a). Ayers and colleagues (2016) differentiated risk factors for PTSD by pre-birth, during birth, and after birth. Depression, fear of childbirth, poor health or pregnancy complications, history of PTSD, and counseling for pregnancy or birth were identified as pre-birth risk factors. Risk factors during birth included a negative subjective birth experience, operative birth (assisted vaginal or cesarean), lack of support, and dissociation. Poor coping and stress were noted as after birth risk factors. Additional risk factors noted by other researchers include past traumas, labor pain, fear of loss of control, and selected demographics, including younger age (Andersen et al., 2012; Dekel et al., 2017; Grekin and O'Hara, 2014).

Strongly associated with PTSD is depression (Dikmen-Yildiz et al., 2017a, 2017b). Depression is a significant risk factor for health consequences among adolescents. Nearly 20% of youth will experience at least one major depressive episode over a 12 month period (NIMH, 2015). Up to 20% of adolescents display symptoms

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prenatally and during postpartum (Meltzer-Brody et al., 2013; Torres et al., 2017). Researchers have reported postpartum depression (PPD) rates as high as 53%–61% for adolescent groups (Clare and Yeh, 2012; Logsdon et al., 2005). A history of violence, anxiety, and/or depression; stressful life events; and non-Caucasian ethnic group have been found to associate with depression symptoms (Verreault et al., 2014). Risk factors for PPD, however, may vary between age groups. Nunes and Phipps (2013) compared prenatal risk factors for PPD among adolescent (ages 15–19) and adult mothers and found symptoms for adults were impacted by maternal race, pregnancy intention, income, prior depression/other mental health issues, stressors, and social support. For adolescents, prior depression and social support contributed to symptoms of PPD. Young age has also been associated with depression symptoms, and older adolescents (ages 18 to 20) have been found to report more symptoms of depression and stress in late pregnancy and early postpartum than young adult women (ages 21 to 24) (Mollborn and Morningstar, 2009; Torres et al., 2017).

Of the minority of women developing postpartum PTSD or depression, symptoms typically decline over time, yet, for some women, symptoms linger months or years (Beck, 2004; Dikmen-Yildiz et al., 2017b; Madigan et al., 2014; Sumner et al., 2012). Persistent PTSD symptoms among adults have been associated with intrapartal events such as cesarean birth and infant complications, as well as pre-birth risk factors of intimate partner violence and depression (Clout and Brown, 2015; Dikmen-Yildiz et al., 2017b; Holditch-Davis et al., 2015; Kim et al., 2015; Ogbonnaya et al., 2013; Sumner et al., 2012). Dikmen-Yildiz et al. (2017b) found the most robust predictor of posttraumatic stress symptoms (PTSS) at six months postpartum was earlier PTSS at 4–6 weeks. Neither duration nor reason for sustained PTSD symptoms has been explored among childbearing adolescent groups; however, PPD symptoms have been found to decline less rapidly over time for adolescents reporting a history of sexual abuse (Madigan et al., 2014).

While limited longitudinal studies are available describing childbearing adolescent depression, no known longitudinal studies describing PTSD among adolescents exist. Published meta-analyses, focused on PTSS or PTSD, either indicate no inclusion of studies among childbearing adolescents of younger ages under 18, or fail to break out study results for included older adolescent age groups of 18–20. Mean age values provided in studies suggest few adolescent subjects. Yet, given numerous potential risk factors, childbearing adolescents may be more likely than adults to experience PTSS or PTSD, but research is lacking.

In light of this identified research gap, the primary aim of the current study was to explore symptoms of early stress at 72 hours postpartum, and determine if early symptoms predicted PTSS at three, six, and nine months postpartum among childbearing adolescents ages 13 to 19. The term early stress was used to indicate

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symptoms at initial assessment. Later symptoms assessed were defined as PTSS. Our use of a screening measure prevented a diagnosis of PTSD. Additionally, because of the frequency of depression among adolescents, and a recognized co-morbidity between depression and PTSD among childbearing adult samples, a secondary study aim was to explore early depression symptoms and determine if early symptoms predicted later depression symptoms at three, six, and nine months postpartum.

2. Materials and methods

2.1. Study design

This prospective longitudinal study was conducted in one large, public hospital in north Texas serving a high Spanish speaking population, and reporting an annual birth rate of 5000 births, equivalent to 20% of the county's deliveries. Data were collected at four time points: through an initial interview in the postpartum unit at 72 hours of birth, and at 3, 6, and 9 months per telephone interviews. Information related to the variables of interest and demographics of mother and infant was collected at initial interview; follow-up interviews provided data regarding PTSS, depression symptoms, and partner violence.

2.2. Sample

A convenience sample of 303 adolescents was recruited from two large postpartum units. Following informed consent, adolescents able to read and speak English or Spanish, of postpartum status near 72 hours, and 13−19 years of age were included in the study. There were no exclusion criteria; all adolescents meeting inclusion criteria were approached for possible study enrollment. Over 90% of adolescents approached, willingly completed the initial survey materials. With some initial missing data for early stress and depression screens, 280 and 282 adolescents provided data respectively. With significant attrition over time, 68 and 65 adolescents presented at Time 2 (3 months postpartum) and 105 and 108 at Time 3 (pooled for 6−9 months postpartum). Thirty-eight adolescents completed measures of stress/PTSS at all time points, and 37 correspondingly completed measures for depressive symptoms. One hundred and twenty one adolescents completed measures of stress/PTSS for a minimum of two time points, and 125 completed corresponding measures for depressive symptoms. Treatment of missing data is further discussed in Statistical Analysis. Of the initial 303 adolescents who participated, our overall N was 295, meaning that each of the 295 had some information to contribute to the overall model at some point during the study period. A listing of the main data patterns across the three time points for the pooled model is provided in Table 1.

We also considered another model in which the pooled 6−9 months data were broken out into two separate time points. In that case, we used bootstrap sampling

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Table 1. Main Data Patterns for Pooled Model. This shows the main data patterns for the pooled model (specifically, here, those data patterns for which there were more than 5 occurrences). As such, 155 subjects provided responses on Early Stress and Depression within 72 hours of childbirth. 59 of the original 155 subjects also provided responses on PTSS and Depression at 6 months or later, while 37 of the original 155 provided responses at all three time points. In addition, another 23 provided responses at both the initial and 3 month time points but not later.

	Data Patterns (X = not missing)			
Within 72 hours of childbirth:				
Early Stress	X	X	X	X
Depression	X	X	X	X
3 months after childbirth:				
PTSS			X	X
Depression			X	X
6–9 months after childbirth				
PTSS		X	X	
Depression		X	X	
	155	59	37	23

to obtain our estimates due to the limited distribution of the data. A brief summary of these results is provided later.

2.3. Measures

We examined stress and PTSS over all time points via the Impact of Event Scale, IES (Horowitz et al., 1979). The IES is a self-rating scale that screens for intrusion and avoidance (two diagnostic indicators for PTSD), by relating specific actions or feelings to a "traumatic" event, such as "had dreams about it," and has been used for several years to measure early stress and extended postpartum PTSS among childbearing adults with acceptable reliability (Kersting et al., 2005; Garthus-Niegel et al., 2013; Ryding et al., 1998). Test-retest reliability ($r = 0.79–0.89$) and internal consistency (Cronbach alpha = 0.78 to 0.82) has been demonstrated to be satisfactory. Reliability of the IES in the current study was established to be 0.87. The 15-item IES generates a total score between 0 and 75, with higher scores indicating more trauma impact. Trauma symptom scores range from 0-8 (subclinical); 9 to 25 (mild); 26 to 43 (moderate); to 44 plus (severe).

To address our secondary study aim, we screened for symptoms of depression using the Edinburgh Postnatal Depression Inventory, EPDS (Cox et al., 1987). A systematic review of 115 studies cited the EPDS as the best screening measurement tool in the category of depression (Nast et al., 2013). The 10-item EPDS has shown adequate reliabilities among multicultural and multiethnic adolescent populations

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(Birkeland et al., 2005). A split-half reliability of 0.88 and alpha coefficient of 0.87 among adult populations have been reported (Downie et al., 2003). Venkatesh et al. (2014) reported convergent validity established with the DSM-IV and sensitivities of 90% and specificities of >85%. Reliability established for the current study was 0.82. Four possible responses to each of the 10 questions are scored from 0-3, creating a range between 0 and 30, with higher scores indicating a higher likelihood for depression. A score of 10 or more indicates symptoms suggestive of minor depression, and a score of 13 and above indicates symptoms of major depression (Cox et al., 1987; Matthey et al., 2006).

By asking the adolescents directly, the following demographic information was collected for analysis: adolescent's age, type of birth, martial status, ethnicity, parity, infant gestational age, and violence exposure (current or history of child or partner abuse). A retrospective capture of feelings prior to birth was rated "usually happy" to "always sad" on a 5-point rating scale. One item added later to the study protocol addressed feelings prior to pregnancy via an identical 5-point rating scale. At 3, 6, and 9 month follow-up telephone interviews, the IES and EPDS were re-administered, as well as a repeated inquiry regarding partner violence.

2.4. Procedure

This study received institutional review board (IRB) approval from the University of Texas at Arlington and John Peter Smith Hospital. Upon arrival to the postpartum unit, hospital personnel, aware of our study, provided a listing of adolescents to the data collector. Data collectors, either the principle investigator (PI) or a graduate research assistant (GRA), approached the adolescent in her postpartum room. Survey information was collected after confirmation of eligibility, a full study explanation, and obtaining of assent/consent and/or parent/guardian consent as needed (of minors under 18). Typically, survey items were read with the adolescent and questions were addressed before end of interview. Adolescents were reminded they had a right to omit questions and withdraw from the study at any time without changes in care. Resources and referrals were provided as needed, or at request, and information for telephone follow-up contact was obtained. Adolescents were contacted by telephone for follow-up data collection at Time 2 and 3 by either the PI or the current study GRA. Adolescents not responding to follow-up calls were recalled one to three times before withdrawal from the study. Initial interviews were about 45−60 minutes; follow-up telephone contacts averaged around 15 minutes.

2.5. Statistical analysis

We used descriptive statistics to calculate means and percentages to describe our study adolescents. We also conducted some separate regression analyses of the dataset at each cross-sectional time point to predict if early occurring variables

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influenced outcomes at initial or later time points. To assess differences in mean scores across all time points for stress/PTSS and depression symptoms, both parametric tests (paired t-test) and non-parametric tests (Wilcoxon signed rank test) were used. To estimate predictions of symptoms over time, we developed a lagged autoregressive model in which each measure subsequent to the initial was regressed on its preceding measure. Specifically, we estimated the effect of stress/PTSS and depression symptomology measured at each time point on subsequent outcome measures across the postpartum period, allowing stress/PTSS and depression symptoms to be correlated at each time point. Because of high attrition, data from the six and nine month time points were pooled into one for our primary statistical model, so that this model addressed three distinct time points: 72 hours postpartum, three months postpartum, and six-nine months postpartum. To address the problem of missing data between initial and follow-up time points, we estimated the model using robust maximum likelihood under the MAR (missing at random) assumption. The estimation procedure incorporated missing data correlates for pre-existing trauma, anxiety, infant complications (gestational age), pain, partner presence, and delivery type. While these variables were not part of the analytic model, the presence of such covariates increases the plausibility of the MAR assumption of maximum likelihood estimation (Collins et al., 2001; Enders, 2002; Graham, 2003; Muthen and Muthen, 1998−2012), although we obtained near identical estimates with and without the inclusion of these auxiliary variables. We also considered a more fully specified "cross-lagged" model in which stress/PTSS also predicted later values of depression, and in which depression also predicted later values of PTSS, and where all the auxiliary variables mentioned above were included as covariates. However, this latter model did not contribute any effects of interest nor modify previous estimates in any substantive way. As such, we report results from the simpler model, which has neither the covariates nor the cross-lagged effects specified.

For our primary model, we employed a Huber-White sandwich estimator (Muthen et al., 2017), which is robust against non-normality and heteroscedasticity, the latter of which we observed in the relationship between PTSS at 3 months and PTSS at 6−9 months (as seen in Fig. 1).The structural model is depicted in Fig. 2. Because this is a first attempt of work in an unexplored area, we created a second (unpooled) model in which the data for the 6−9 month period is disaggregated into two separate time points. For this model, we used bootstrap sampling due to the limited distribution of the data across all 4 time points, drawing 10,000 samples to obtain non-symmetric bootstrap confidence intervals.

3. Results

Adolescents were primarily single, older, Hispanic, first time mothers of full-term, vaginally delivered infants. Initially, over 20% reported current or past violence,

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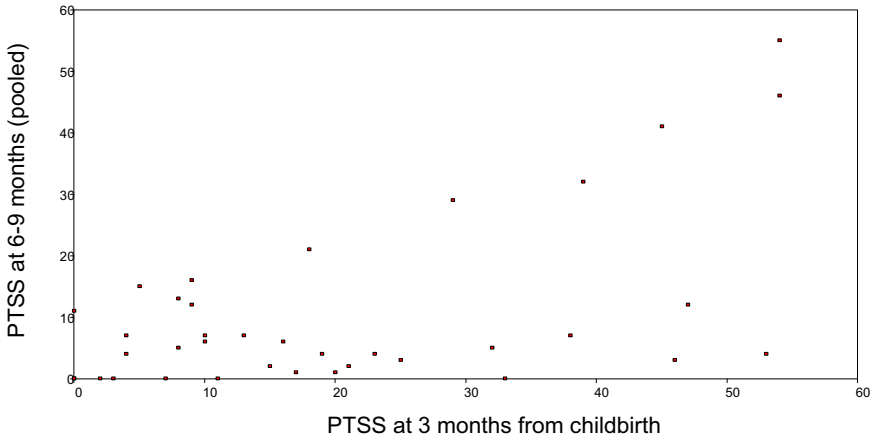

Fig. 1. Scatterplot of PTSS at 6−9 months (Pooled) versus PTSS at 3 months. In this model, an adolescent's IES score for PTSS at 6−9 months (pooled) is plotted against her IES score for PTSS at 3 months. The resulting pattern suggests the presence of heteroscedasticity.

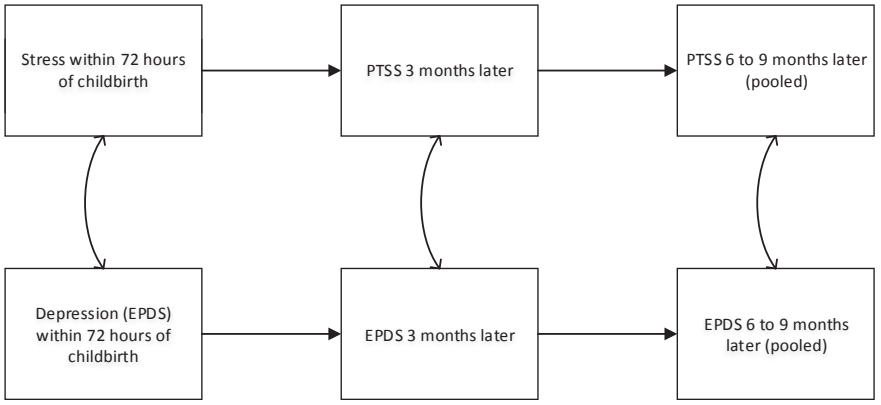

Fig. 2. Conceptual Model of Stress (PTSS) and Depression Development from Childbirth to 6−9 Months Later (Pooled). In this model, PTSS at 3 months is regressed on PTSS at birth, while PTSS at 6−9 months (pooled) is regressed on PTSS at 3 months. The same regression structure is applied to the respective Depression (EPDS) time point measures. In addition, Stress and Depression recorded within 72 hours of childbirth are allowed to covary, and the residual variances of PTSS and Depression are also allowed to correlate at the later time points (as indicated by the curved connectors).

primarily partner related; at follow-up, seven adolescents disclosed partner violence. Feelings of sadness "usually" or "always" prior to birth and pregnancy were retrospectively reported by less than 10% of adolescents. Immediately after birth one in three adolescents reported moderate to severe stress and one in four adolescents reported minor or major depression symptoms. At final assessment, 20% of individual adolescents displayed both moderate to severe PTSS and minor or major depression symptoms (Table 2). Overall, symptoms did not decline until 6 months following childbirth; however, mean scores at each time point indicated only mild stress or PTSS and low likelihood of depression symptoms, rather than severe

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Table 2. Sample characteristics.

Time	72 hours postpartum		3 months		6–9 months	
	n	%	n	%	n	%
Variable						
Age Mean = 17.87/SD = 1.39						
Range = 13–19						
Birth type						
Vaginal	230	78.5				
Cesarean	63	21.5				
Marital Status:						
Single	257	84.8				
Ethnicity/Race						
White	31	10.6				
Black	75	25.6				
Hispanic	183	62.5				
Parity = 1	227	77.5				
Gestational age						
Preterm (<37)	32	11.4				
Current/history violence (child and/or partner)						
No	229	79.8	60	92.3	86	96.6
Yes	58	20.2	5	7.7	3	3.4
EPDS						
0–9	210	75.2	52	75.4	92	80.0
10–2 (minor)	32	11.4	11	15.9	8	7.0
13+ (major)	38	13.5	6	8.7	15	13.0
IES						
0–8 (subclinical)	93	33.2	22	32.4	44	39.2
9–25 (mild)	100	35.7	27	39.7	46	41.1
26–43 (moderate)	68	24.3	12	17.6	13	11.6
44+ (severe)	19	6.8	7	10.3	9	8.0

symptoms (Table 3). This same pattern was found using both parametric tests (paired t-test) and non-parametric tests (Wilcoxon signed rank test).

3.1. Cross-sectional characteristics results summary

As expected, initial stress and depression scores were strongly correlated, ($r = .52$, $p = 0.000$). Depression and partner violence predicted elevated stress at 72 hours following birth; yet, later depression did not predict later measures of PTSS at subsequent time points. We were unable to determine the role of violence on later symptoms with only seven adolescents disclosing violence at later time points. Early gestational age also was found not to predict initial or later stress/PTSS (IES scores) but did predict initial depression (EPDS scores). Later measure of depression was

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Table 3. Summary information on variables by time point.

Variables	Mean	S.D.	N
Within 72 hours of childbirth			
Early Stress	18.15	15.17	280
Depression	6.04	4.80	282
3 months after childbirth			
PTSS	18.84	15.74	68
Depression	5.87	4.99	69
6 months after childbirth			
PTSS	17.29	14.71	73
Depression	6.00	5.29	75
9 months after childbirth			
PTSS	13.95	15.69	62
Depression	4.37	3.74	63
6–9 months after childbirth (pooled)			
PTSS	15.87	15.19	105
Depression	5.62	4.97	108

also predicted by early gestational age, but only if adolescents showed sustained depression beyond six months. Type of delivery showed no effect on stress/PTSS or depression at any time point.

3.2. Prediction of symptoms

The statistical models for the lagged autoregressive models were specified as a single path analysis using the M*plus* software (Muthen and Muthen, 1998–2012) so that all the estimates summarized below were derived simultaneously. The first (pooled) model exhibited favorable fit statistics. The non-significant chi-square test of model fit ($\chi 2 = 6.998$, df $= 6$, p-value $= 0.32$) indicated the hypothesis that our postulated model holds in the population cannot be rejected. Other fit statistics provided support for the postulated model (RMSEA $= 0.024$, CFI $= 0.994$). These reflected the fact that our specified model was not fully saturated; that is, we did not estimate every possible path effect in the model (such as the effect of depression symptoms at childbirth directly on depression symptoms 6–9 months later) and there were no statistically discernible effects for those paths we excluded.

The fully standardized robust maximum likelihood estimates for the first model are summarized in Table 4. Here, a one standard deviation increase in both PTSS and depression symptoms at the 3 month time point is associated with a one-half a standard deviation increase on respective symptoms 6–9 months later. These are medium sized effects based on Cohen's (1992) effect size classification. Residual variances were also correlated at each time point as hypothesized, but there were no statistically discernible effects for stress and depression symptoms immediately following childbirth on symptoms at 3 months.

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Table 4. Robust standardized maximum likelihood estimates for the effects of PTSS and EPDS symptoms on later respective symptoms.

	Estimate	S.E.	Est./S.E.	P-Value
PTSS at 6−9 months				
PTSS at 3 months	0.505	0.127	3.987	0.000
PTSS at 3 months				
Early stress at birth	0.102	0.103	0.987	0.324
Depression at 6−9 months				
Depression at 3 months	0.602	0.121	4.957	0.000
Depression at 3 months				
Depression at birth	0.155	0.104	1.489	0.137
Covariances:				
PTSS with Depression (at 6−9 months)	0.446	0.127	3.499	0.000
PTSS with Depression (at 3 months)	0.579	0.086	6.763	0.000
Early stress with Depression (childbirth)	0.518	0.045	11.529	0.000
Intercepts:				
PTSS at 6−9 months	0.745	0.128	5.822	0.000
PTSS at 3 months	0.990	0.021	46.898	0.000
Depression at 6−9 months	0.638	0.146	4.366	0.100
Depression at 3 months	0.976	0.032	30.237	0.000

We also obtained this same pattern of results, using an unpooled model in which the data for the 6−9 month period was broken out separately employing bootstrap sampling. As with the first model, medium effect sizes were obtained for the effects of PTSS and depression symptoms at the 3 month time point on symptoms three months later. Further, effect sizes of the same order of magnitude were obtained for the effects of PTSS and depression symptoms at the 6 month time point on symptoms at 9 months.

4. Discussion

This study was unique in that it examined prevalence and patterns of stress and depression across nine months in an adolescent postpartum population. We observed that about 30% of postpartum adolescents displayed early symptoms, and 20% showed symptoms at the final time point. We found that symptoms of stress and depression at birth did not predict symptoms at three months; however, symptoms at three months did predict symptoms at six to nine months. For the majority of adolescents, symptoms were of a milder nature and reduced over time, but decline was slower for the first three months, especially for depression symptoms. Pre-existing or birth related stressors may have influenced initial symptoms as well as re-emerging, delayed, sustained, or potentially chronic, symptoms at later time points.

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Initially, at 72 hours postpartum about one-third of adolescents reported early moderate to severe stress, with slightly fewer teens reporting minor or major depression symptoms. Some initial stress following childbirth can be expected. After any traumatic event, individuals often display symptoms of stress as they work to process an event into manageable pieces to prevent feeling totally overwhelmed (Horowitz, 1986). For our adolescents, initial, early stress symptoms were also found to be influenced by pre-existing depression and violence. Depression symptoms noted in early postpartum in adult populations have been suggested to reflect late pregnancy symptoms or ongoing symptoms prior to pregnancy (Gavin et al., 2005; Seng et al., 2009). In the current study 10% of adolescents felt "usually" or "always sad" during pregnancy; however, our lack of prenatal data prevented detailed assessment of adolescent pre-existing mental health prior to birth or pregnancy.

A history of violence was also found to have contributed to initial symptoms of adolescent stress in the current study. Violence (trauma) has been cited as contributing to PTSS (Dekel et al., 2017; Dikmen-Yildiz et al., 2017b). Diagnosed PTSD affects about 7% of non-childbearing adolescents resulting from a variety of traumatic exposures; most commonly, interpersonal types of trauma, such as partner abuse (McLaughlin et al., 2013). Among non-childbearing adolescents, exposure to interpersonal violence increases the risk of PTSD and depression, and of diagnostic comorbidity (Kilpatrick et al., 2003). The percentage of prenatal PTSD among adolescents is unknown; yet, about 14% of adult women seeking maternity care in public-payer settings (similar to our setting) have been found to display symptoms of current PTSD when first entering into prenatal care (Seng et al., 2009).

Gestational age was found to indirectly contribute to initial stress symptoms. Early depression symptoms were influenced by gestational age; therefore, a premature birth may have intensified ongoing symptoms of depression, and indirectly increase initial stress levels. Adverse infant outcomes among childbearing adults have been shown to lead to symptoms of acute stress disorder and depression within the first week of birth (Jubinville et al., 2012; Lefkowitz et al., 2010). In the current study, over 11% of adolescents reported birth of a premature infant as compared to the national average of 9.80% (March of Dimes Premature Birth Report Card, 2017). Lower gestational age correlated with cesarean birth; however, cesarean birth was not found to affect initial symptoms of stress or depression. This finding is contrary to most studies, and several meta-analyses have indicated the impact of cesarean birth on PTSD (Andersen et al., 2012; Grekin and O'Hara, 2014). While nearly 22% of adolescents reported a cesarean birth, initial stress symptoms may have been reduced by increased attention and support from mother, partner, and/or caregiver to the adolescent as she prepared for this surgical event.

Emotional support has been identified as one of three nursing behaviors that adolescents perceive as most helpful in labor (Sauls, 2004). Following birth the support of

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family and a significant other is important. The lack of social support has been suggested as a major predictor of adolescent PPD (Nunes and Phipps, 2013), and a risk factor for contributing to PTSS in adult samples (Dekel et al., 2017).Early support provided shortly after hospital discharge may have contributed to the apparent stability between early and three month stress and depression symptoms. In the current study, the average adolescent age was over 17 and the father of the baby may have been a very important source of potential or actual support.

Most adolescent mothers experience a normative transition in which the influence by parental figures becomes outweighed by the influence of peers and romantic partners (Milan et al., 2004). Support and greater relationship quality with a significant other have been shown to associate with reduced perceived stress and depression among postpartum Hispanic adolescents (Easterbrooks et al., 2016; Meltzer-Brody et al., 2013). Meltzer-Brody and colleagues (2013) found that around six weeks, general support and support from the father of the baby increased, which researchers termed the "honeymoon period." After a few months, however, researchers hypothesized that support would diminish, and depression would increase.

In a secondary analysis of qualitative data, DeVito (2010) found that by four to six weeks postpartum, adolescent mothers (primarily older, Hispanic) felt they were living every day the same as the last, and that they felt abandoned by friends, overwhelmed, alone, and desperate, especially when the father of the baby had failed to live up to expectations. With the importance adolescents often place on peers and/or the relationship with the father of the baby, loss of these figures in later postpartum might have led to delayed symptoms reported at final time points.

For the majority of adolescents initial symptoms declined over time. By six months to a year, researchers frequently have found a decline in PTSS among childbearing adults, and a decline in depression symptoms among adults and adolescents (Bell et al., 2016; Dikmen-Yildiz et al., 2017b; Madigan et al., 2014). Yet, there are some inconsistencies in the literature. In the current study, numerous stressors during the extended postpartum may have led to a re-emergence of symptoms or promoted delayed or sustained symptoms. In general, however, PTSD symptoms can be delayed until at least six months after a traumatic event (American Psychological Association, 2013). Up to 20% of non-childbearing adults and youths do not manifest clinically significant symptoms of PTSD for several months or years following an initial trauma exposure (Smid et al., 2009).

It is not clear why 20% of the current study adolescents displayed symptoms at the final time point. If symptoms were chronic, one might expect initial symptoms to predict three month symptoms, unless increased support and attention to mother and infant in early postpartum acted as a protective factor. A prediction at three months of later symptoms may indicate re-emerging or delayed symptoms, related to the birth, or other unexplored stressors such as loss of support or return to school.

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We sought to explore if ongoing depression, violence, or preterm or cesarean birth may have influenced symptoms at later time points; however, these potential stressors showed no significant effects. However, small sample sizes at later time points, especially for the disclosure of violence, prevented a clear picture regarding the true role of these covariates.

Few studies exist that have explored maintaining factors for PTSS/PTSD or depression over time (Garthus-Niegel et al., 2015; Madigan et al., 2014); however, among adults, insomnia, low support, and negative life events at eight weeks postpartum have been found to associate with PTSD symptoms at two years postpartum (Garthus-Niegel et al., 2015). Further, resolution of symptoms among postpartum women may be prevented by the challenging transition to motherhood, including coping with a newborn, or sleep deprivation (Dikmen-Yildiz et al., 2017a). These stressors may particularly relate to adolescents who in the current study varied in age, therefore, most likely in level of cognitive maturity, coping skills when faced with stress, and differing abilities to adjust to the maternal role, especially if low parental or partner support.

With no available research to offer comparisons in study findings between adolescents, or adults and adolescents, and with recognized caution, we offer speculation related to the stress of birth for adolescents. Given the rate of violence reported initially (20%), if we were to consider that symptoms of stress at initial assessment are more likely pre-existing to birth, or potentially chronic, and/or reflective of possibly PTSS, our finding of 30% suggests a potential prenatal rate that is higher than that reported by Seng et al. (2009) of 14% percent for adult women who enter prenatal care with PTSD. With potentially higher rates for prenatal or pre-pregnancy symptoms (stress/PTSS), adolescents may be at higher risk for PTSS or PTSD postpartum. Symptoms indicative of PTSS at six months postpartum have been predicted by PTSS at earlier postpartum Dikmen-Yildiz et al. (2017b). Further, with several recognized risk factors for PTSS/PTSD at higher incidence among childbearing adolescents than adults, such as violence and depression, an increased vulnerability by adolescents to display PTSS/PTSD at birth or later postpartum may not be an unreasonable concern. We may further speculate that the percentage difference between the 30% (adolescents) and the 14% (adults) leaves 16% of adolescents potentially traumatized solely by birth events. All speculation strongly supports the need for additional research to determine prenatal prevalence of symptoms, and the vulnerability of childbearing adolescents to experience PTSS (and PTSD) over the extended postpartum period.

4.1. Strengths and limitations

This unique study offers a first attempt to examine a previously unexplored area of research. Two strengths of our study include the longitudinal design with three

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distinct time points and the selected population. While limited studies do exist which explore adolescent postpartum depression, studies are non-existent that explore adolescent PTSS over time, and in conjunction with symptoms of depression. Further, the high percent of Hispanic adolescents enrolled in the study may have prevented a true representation of the national population; however, findings did provide interesting insights for an under researched minority group, and one which researchers have reported to have the highest birth rate among all adolescents, as well as high depression rates over the perinatal period (Recto and Champion, 2017). An additional strength is the retrospective assessment of violence exposure (child abuse and partner violence) and depression (sadness) prior to birth, and prospectively at all postpartum time points.

However, the limitations are that our results were based on limited data, especially at later time points, and findings must be considered with caution. Post analysis suggested that, in the case of stress scores, those included in the follow-up surveys had an average initial score that was slightly higher than the average initial scores of those who were not part of the later surveys, suggesting a potential selection bias in the follow-ups.

Additionally, our measurement tools allowed for only a screen of symptoms, excluding a diagnosis of PTSD or depression. Further, the use of the IES as a screen for PTSS among ethnically diverse adolescents requires additional evaluation. Last, our difficulty in collecting prenatal data made it impossible to know if symptoms at birth reflected a pre-existing condition, a traumatic birth event, or a combination of the two (retriggering of symptoms). Further, over the extended postpartum period unknown stressors such as return to school, loss of support, or other events such as increased or ongoing violence, or other events acting as protective factors (therapy, medication, increased support) may have influenced outcomes. More detailed follow-up interviews are warranted. Findings are uncertain but justify additional work in the area; therefore, we invite more follow-up research with larger samples, including a larger, more culturally diverse subgroup of younger adolescents under age 16.

5. Conclusion

This is the first study of its kind to explore early postpartum symptoms of stress and depression and determine if early birth symptoms predicted symptoms in the extended postpartum period among childbearing adolescents ages 13 to 19. Over 30% of adolescents experienced stress and slightly less reported depression symptoms immediately following birth. Symptoms declined over time for the majority. Early symptoms failed to predict symptoms at three months; yet, symptoms at three months were found to predict symptoms at six and nine months postpartum. Twenty

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percent of adolescents reported symptoms at the final time point which may suggest a re-emergence of symptoms, delayed, or sustained symptoms, perhaps, reflective of a chronic nature of symptoms, not necessarily related to birth. Our findings suggest a need for extended follow-up of at risk adolescents beyond hospital discharge. Additional research is needed to determine the perinatal patterns of PTSS and depression, and the stressors or protective factors that lead to symptoms or personal growth in the extended postpartum, especially among younger adolescents of various ethnic-racial backgrounds.

Declarations

Author contribution statement

Cheryl Anderson: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

John Connolly: Analyzed and interpreted the data, Contributed reagents, materials, analysis tools or data, Wrote the paper.

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Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

References

American Psychological Association, 2013. Diagnostic and Statistical Manual of Mental Disorders. American Psychiatric Press, Washington DC, pp. 269−286.

Andersen, L.B., Melvaer, L.B., Videbech, P., Lamont, R.F., Joergensen, J.S., 2012. Risk factors for developing post-traumatic stress disorder following childbirth: a systematic review. Acta Obstet. Gynecol. Scand. 91, 1261−1272.

Ayers, S., Bond, R., Bertullies, S., Wijma, K., 2016. The aetiology of post-traumatic stress following childbirth: a meta-analysis and theoretical framework. Psychol. Med. 46, 1121−1134.

 https://doi.org/10.1016/j.heliyon.2018.e00965

Beck, C.T., 2004. Birth trauma: in the eye of the beholder. Nurs. Res. 53 (1), 28–35.

Bell, A.F., Carter, C.S., Davis, J.M., Golding, J., Adejumo, O., Pyra, M., Connelly, J.J., Rubin, L.H., 2016. Childbirth and symptoms of postpartum depression and anxiety: a prospective birth cohort study. Arch Womens Ment Health 19, 219–227.

Birkeland, R., Thompson, J.K., Phares, V., 2005. Adolescent motherhood and postpartum depression. J. Clin. Child Adolesc. Psychol. 34, 292–300.

Clare, C.A., Yeh, J., 2012. Postpartum depression in special populations: a review. Obstet. Gynecol. Surv. 67, 313–323.

Clout, D., Brown, R., 2015. Sociodemographic, pregnancy, obstetrics and postnatal predictors of postpartum stress, anxiety and depression in new mothers. J. Affect. Disord. 188, 60–62.

Cohen, J., 1992. A power primer. Psychol. Bull. 112, 155–159.

Collins, L.M., Shafer, J.L., Kam, C.H., 2001. A comparison of inclusive and restrictive strategies in modern missing data procedures. Psychol. Methods 6, 330–351.

Cox, J.L., Holden, J.M., Sagovsky, R., 1987. Detection of postnatal depression: development of the 10-item Edinburgh postnatal depression scale. Br. J. Psychiatry 150, 782–786.

Dekel, S., Stuebe, C., Dishy, G., 2017. Childbirth induced posttraumatic stress syndrome: a systematic review of prevalence and risk factors. Front. Psychol. 8, 560–571.

DeVito, J., 2010. How adolescent mothers feel about becoming a parent. J. Perinat. Educ. 19 (2), 25–34.

Dikmen-Yildiz, P.D., Ayers, S., Phillips, L., 2017a. The prevalence of posttraumatic stress disorder in pregnancy and after birth: a systematic review and meta-analysis. J. Affect. Disord. 208, 634–645.

Dikmen-Yildiz, P.D., Ayers, S., Phillips, L., 2017b. Factors associated with posttraumatic stress symptoms (PTSS) 4-6 weeks and 6 months after birth: a longitudinal population-based study. J. Affect. Disord. 221, 238–245.

Downie, J., Wynaden, D., McGowan, S., Juliff, D., Axten, C., Fitzpatrick, L., Painter, S., 2003. Using the edinburgh postnatal depression scale to achieve best practice standards. Nurs. Health Sci. 5, 283–287.

https://doi.org/10.1016/j.heliyon.2018.e00965

Easterbrooks, M.A., Kolake, C., Raskin, M., Bumgarner, E., 2016. Patterns of depression among adolescent mothers: resilience related to father support and home visiting program. Am. J. Orthopsychiatry 86, 61–68.

Enders, C.K., 2002. Applied Missing Data Analysis. Guilford Press, New York.

Ganchimeg, T., Ota, E., Morisaki, N., Laopaiboon, M., Lumbiganon, P., Zhang, J., et al., WHO Multicountry Survey on Maternal Newborn Health Research Network, 2014. Pregnancy and childbirth outcomes among adolescent mothers: a world health organization multicounty study. BJOG 121, 40–48.

Garthus-Niegel, S., Ayers, S., von Soest, T., Torgersen, L., Eberhard-Gran, M., 2015. Maintaining factors of posttraumatic stress symptoms following childbirth: a population- based two year study. J. Affect. Disord. 172, 146–152.

Garthus-Niegel, S., von Soest, T., Vollrath, M.E., Eberhard-Gran, M., 2013. The impact of subjective birth experiences on post-traumatic stress symptoms: a longitudinal study. Arch. Wom. Ment. Health 16, 1–10.

Gavin, N.I., Gaynes, B.N., Lohr, K.N., Meltzer-Brody, S., Gartlehner, G., Swinson, T., 2005. Perinatal depression: a systematic review of prevalence and incidence. Obstet. Gynecol. 106, 1071–1083.

Graham, J.W., 2003. Adding missing-data relevant variables to FIML-based structural equation models. Struct. Equ. Model. 10, 80–100.

Grekin, R., O'Hara, M., 2014. Prevalence and risk factors of postpartum stress disorder: a. meta- analysis. Clin. Psychol. Rev. 34, 389–401.

Holditch-Davis, D., Hudson, S., Levy, J., White-Traut, R., O'Shea, M., Geraldo, V., David, R., 2015. Patterns of psychological distress in mothers of preterm infants. Infant Behav. Dev. 41, 154–163.

Horowitz, M.J., 1986. Stress Response Syndromes. Jason Aronson, Northvale, New Jersey.

Horowitz, M.J., Wilner, N., Alvarez, W., 1979. Impact of events scale: a measure of subjective stress. Psychosom. Med. 41, 209–218.

Jubinville, J., Newburn-Cook, C., Hegadoren, K., Lacaze-Masmonteil, T., 2012. Symptoms of acute stress disorder in mothers of premature infants. Adv. Neonatal Care 12, 246–253.

Kersting, A., Dorsch, M., Wesselmann, U., Ludorff, K., Witthaut, J., Ohrmann, P., Arolt, V., 2005. Maternal posttraumatic stress response after the birth of a very low birth weight infant. J. Psychosom. Res. 57, 473–476.

https://doi.org/10.1016/j.heliyon.2018.e00965

Kilpatrick, D.G., Ruggiero, K.J., Acierno, R., Saunders, B.E., Resnick, H.S., Best, C.L., 2003. Violence and risk of PTSD, major depression, substance abuse/dependence, and comorbidity: results from the national survey of adolescents. J. Consult. Clin. Psychol. 71, 692−700.

Kim, W.J., Lee, E., Kim, K.R., Namkoong, K., Park, E.S., Rha, D.W., 2015. Progress of PTSD symptoms following birth: a prospective study in mothers of high-risk infants. J. Perinatol. 35, 575−579.

Lefkowitz, D.S., Baxt, C., Evans, J.R., 2010. Prevalence and correlates of posttraumatic stress and postpartum depression in parents of infants in the neonatal intensive care unit (NICU). J. Clin. Psychol. Med. Settings 17, 230−237.

Logsdon, M.C., Birkimer, J.C., Simpson, T., Looney, S., 2005. Postpartum depression and social support in adolescents. J. Obstet. Gynecol. Neonatal Nurs. 34, 46−54.

Madigan, S., Wade, M., Plamondon, A., Vaillancourt, K., Jenkins, J.M., Shouldice, M., Benoit, D., 2014. Course of depression and anxiety symptoms during the transition to parenthood for female adolescents with histories of victimization. Child Abuse Neglect 38, 1160−1170.

March of Dimes Premature Birth Report Card, 2017. http://www.multivu.com/players/English/8189251-,arch-of-dimes-premature-birth-report- card-2017/. (Accessed 4 March 2018).

Matthey, S., Henshaw, C., Elliott, S., Barnett, B., 2006. Variability in use of cut-off scores and formats on the Edinburgh Postnatal Depression Scale: implications for clinical and research practice. Arch. Wom. Ment. Health 9, 309−315.

McLaughlin, K.A., Koenen, K.C., Hill, E.D., Petukhova, M., Sampson, N.A., Zaslavsky, A.M., Kessler, R.C., 2013. Trauma exposure and posttraumatic stress disorder in a national sample of adolescents. J. Am. Acad. Child Adolesc. Psychiatry 184, 815−830.

Meltzer-Brody, S., Bledsoe-Mansori, S.E., Johnson, N., Killian, C., Hamer, R.M., Jackson, Thorp, J., 2013. A prospective study of perinatal depression and trauma history in pregnant minority adolescents. Am. J. Obstet. Gynecol. 208, 211.e1-e7.

Milan, S., Ickovics, J.R., Kershaw, T., Lewis, J., Meade, C., Ethier, K., 2004. Prevalence, course, predictors of emotional distress in pregnant and parenting adolescents. J Counsel Clin Psychol 72, 328−340.

Mollborn, S., Morningstar, E., 2009. Investigating the relationship between depression and childbearing using longitudinal evidence. J. Health Soc. Behav. 50, 310−326.

https://doi.org/10.1016/j.heliyon.2018.e00965

Muthen, B.O., Muthen, L.K., Asparouhov, T., 2017. Regression and Mediation Using Mplus. Muthen & Muthen, Los Angeles, CA.

Muthen, L.K., Muthen, B.O., 1998–2012. Mplus User's Guide, seventh ed. Muthen & Muthen, Los Angeles, CA.

Nast, I., Bolten, M., Meinischmidt, G., Heilhammer, D.H., 2013. How to measure perinatal stress? A systematic review of psychometric instruments to assess psychosocial stress during pregnancy. Pediatric Perinatal Epidemiol 27, 313–322.

National Institute of Mental Health (NIMH), 2015. Transforming the Understanding and Treatment of Mental Illnesses. http://www.nimh.nih.gov/health/statistics/prevalence/major-depression-among-adolescents.shtml. (Accessed 27 December 2017).

Nunes, A.P., Phipps, M.G., 2013. Postpartum depression in adolescent and adult mothers: comparting prenatal risk factors and predictive models. Matern. Child Health J. 17, 1071–1079.

Ogbonnaya, I.N., Macy, R.J., Kupper, L.L., Martin, S.L., Bledsoe-Mansori, S.E., 2013. Intimate partner violence and depressive symptoms before pregnancy, during pregnancy, and after infant delivery: an exploratory study. J. Interpers Violence 28, 218–225.

Papri, F.S., Khanam, Z., Ara, S., Panna, M.B., 2016. Adolescent pregnancy: risk factors, outcome and prevention. Chattagram MOS Hosp Med College J 15, 53–56.

Recto, P., Champion, J.D., 2017. Assessment of mental health literacy among perinatal Hispanic adolescents. Issues Ment. Health Nurs. 38, 1030–1038.

Ruedinger, E., Cox, J.E., 2012. Adolescent childbearing: consequences and interventions. Curr. Opin. Pediatr. 24, 446–452.

Ryding, E.L., Wijma, K., Wijma, B., 1998. Psychological impact of emergency cesarean section in comparison with elective cesarean section, instrumental and normal vaginal delivery. J. Psychosom. Obstet. Gynecol. 19, 135–144.

Sauls, D.J., 2004. Adolescent's perception of support during labor. J. Perinat. Educ. 13, 36–43.

Seng, J.S., Low, L.K., Sperlich, M., Ronis, D.L., Liberzon, I., 2009. Prevalence, trauma history, and risk for posttraumatic stress disorder among nulliparous women in maternity care. Obstet. Gynecol. 114, 839–847.

Siegel, R.S., Brandon, A.R., 2014. Adolescents, pregnancy and mental health. J. Pediatr. Adolesc. Gynecol. 27, 138–150.

 https://doi.org/10.1016/j.heliyon.2018.e00965

Smid, G.E., Mooren, T.T., van der Mast, R.C., Gersons, B.P., Kleber, R.J., 2009. Delayed posttraumatic stress disorder systematic review, meta-analysis, and meta-regression analysis of prospective studies. J. Clin. Psychiatr. 70, 1572−1582.

Sumner, L.A., Wong, L., Dunkel Schetter, C., Myers, H., Rodriquez, M., 2012. Predictors of posttraumatic stress disorder symptoms among low income Latinas during pregnancy and postpartum. Psychol. Trauma 4, 196−203.

Torres, R., Goyal, D., Burke-Aaronson, A., Gay, C.L., Lee, K.A., 2017. Patterns of symptoms of perinatal depression and stress in late adolescent and young adult mothers. J. Obstet. Gynecol. Neonatal Nurs. 46, 814−823.

Venkatesh, K.K., Zlotnick, C., Triche, E.W., Ware, C., Phipps, M.G., 2014. Accuracy of brief screening tools for identifying postpartum depression among adolescent mothers. Pediatrics 133, e45−e53.

Verreault, N., DaCosta, D., Marchland, A., Ireland, K., Dritsa, M., Khalife, S., 2014. Rates and risk factors associated with depressive symptoms during pregnancy and with postpartum onset. J. Psychosom. Obstet. Gynecol. 35, 84−91.

 https://doi.org/10.1016/j.heliyon.2018.e00965