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Maternal depressive risk in prenatal versus postnatal surgical closure of myelomeningocele: associations with parenting stress and child outcomes

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Abstract

Introduction: Depressive risk is higher for mothers of infants with chronic medical conditions. The present study examined maternal depressive risk and associations with parent and child outcomes among mothers of young children who were randomized to either prenatal or postnatal surgical closure for myelomeningocele.

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Author Contributions

J.E. Schreiber and J.C.M. Cole conducted statistical analyses and interpretation, drafted the initial manuscript, and reviewed and revised the manuscript. A.J. Houtrow reviewed and revised the manuscript. M.J. Kallan conducted statistical analyses and interpretation, and reviewed and revised the manuscript. E.A. Thom, N.S. Adzick and L.J. Howell conceptualized and designed the study, collected data, and reviewed and revised the manuscript.

Statement of Ethics

This study was approved by the Institutional Review Board at each of the participating institutions (Children's Hospital of Philadelphia (IRB No: 2000–11–2226), Vanderbilt University, and the University of California, San Francisco) with all mothers providing written informed consent. This research complies with the guidelines for human studies and was conducted ethically in accordance with the World Medical Association Declaration of Helsinki.

Conflict of Interest Statement

N.S. Adzick is an Editorial Board Member of Fetal Diagnosis and Therapy. The other authors have no conflicts of interest to declare.

Methods: Using the Management of Myelomeningocele Study (MOMS) database, maternal depressive risk was examined at three time points: prior to birth, 12 months and 30 months post birth. Separate multivariate analyses examined associations among change in depressive risk (between baseline and 30 months), parenting stress, and child outcomes at 30 months.

Results: Mean scores were in the minimal depressive risk range at all time points. Post birth depressive risk did not differ by prenatal versus postnatal surgery. Mean change scores reflected a decrease in depressive risk during the first 30 months. Only 1.1%-4.5% of mothers reported depressive risk in the moderate to severe range across time points. Increased depressive risk during the first 30 months was associated with increased parenting stress scores and slightly lower child cognitive scores at 30 months.

Discussion/Conclusion: Most mothers reported minimal depressive risk that decreased over time regardless of whether their infant underwent prenatal or postnatal surgery. Only a small percentage of mothers endorsed moderate to severe depressive risk, but an increase in depressive risk over time was associated with higher parental stress and slightly lower child cognitive development.

Keywords

maternal depression; myelomeningocele; prenatal surgery

Introduction

The perinatal period is commonly recognized as a time when women are at an increased risk for psychological distress. It has been estimated that between 14% and 23% of women in the general population will experience episodes of depression during pregnancy, 16.7% will develop symptoms within 3 months after birth, and 21.9% will experience symptoms within the first 12 months after birth [1–3]. Additionally, antenatal depression is significantly associated with a re-occurrence and/or exacerbation of depressive symptoms within the first year after birth [4–6].

Perinatal depression is frequently underdiagnosed, yet there is substantial research that demonstrates its detrimental effects on fetal development [5,7], parent-child relationships [8], pediatric outcomes [9,10], and partner relationships [11]. Numerous studies have demonstrated that parents of premature infants or infants who required prolonged hospitalization in the neonatal intensive care unit have significant levels of psychological distress and heightened risk for developing depression after birth [12–14]. Few studies, however, have examined expectant mothers carrying fetuses with congenital anomalies [15–18], and no studies to date have examined the rates of depressive symptoms among pregnant women who have undergone intrauterine fetal interventions.

Research suggests that the impact of caring for a child with a chronic illness is associated with parental mental health risk [19–21]. In particular, caregivers of children and adolescents with spina bifida report lower quality of life which has been associated with more parental anxiety and depressive symptoms [22,33]. However, no study has examined how perinatal

depressive symptoms are associated with parenting stress and the functioning of very young children with spina bifida.

The Management of Myelomeningocele Study (MOMS) data provided the opportunity to explore the rates of depressive symptoms among mothers over the first 30 months post birth. The prenatal diagnosis of myelomeningocele, the most severe form of spina bifida, is a likely stressor that may trigger the onset of depressive symptoms in expectant mothers. The purpose of the present study is to compare mothers of young children who were randomized to either prenatal or postnatal surgical closure for myelomeningocele in the following ways: 1) to examine maternal depressive risk (endorsed on the Beck Depression Inventory-II) at three distinct time points and 2) to examine how change in maternal depressive risk between baseline and 30 months is associated with parenting stress and child outcomes at 30 months after birth.

Materials and Methods

The MOMS trial was conducted in three hospitals across the United States, Children's Hospital of Philadelphia, Vanderbilt University, and the University of California, San Francisco. All centers worked in collaboration with an independent data-coordinating center at George Washington University and with the Eunice Kennedy Shriver National Institute of Child Health and Human Development. The trial was approved by the Institutional Review Board at each institution. Details of the study design have been previously described [24,25]. Briefly, women between 19 and 25 weeks gestation carrying a singleton fetus diagnosed with myelomeningocele who met eligibility criteria were randomly assigned to either prenatal or postnatal myelomeningocele surgical closure. Women planned to give birth at 37 weeks gestation at the hospital where they were randomized for the study. Mothers followed up at the hospital when the child was 12 months and 30 months of age, at which time they completed several objective study measures.

The primary outcome of interest for the present study was identifying depressive risk among mothers caring for a young child with spina bifida. Mothers in the study completed the Beck Depression Inventory-II (BDI-II) as a baseline assessment during enrollment in the study, prior to being randomized to receive either prenatal or postnatal surgical closure. The BDI-II was also completed at the child's follow up visits at 12 months and 30 months post birth. The BDI-II is a widely used 21-item self-report measure of depressive symptoms which has been shown to be a reliable and valid measure for the severity of depressive symptomatology in clinical populations [26]. The BDI-II takes approximately 10 minutes to complete and requires a fifth to sixth grade reading level. Each item is answered using a scale value of 0 to 3, with the higher total scores indicating more severe depressive risk. Women who score 21 or above are considered to fall into the moderate to severe depressive risk category.

Mothers also completed the Parenting Stress Index-Short Form (PSI-SF). The PSI-SF, a 36-item self-report measure, compiles a total stress score indicating the overall level of current parenting stress [27]. Items are scored on a Likert scale from 1 to 5, with higher scores reflecting greater parental stress. In addition to the BDI-II and the PSI-SF, caregivers also completed a measure of their child's functional status using the Functional Independence

Measure for Children (WeeFIM). The WeeFIM is a widely used, standardized assessment tool designed to assess and track levels of functional independence in daily tasks in children aged 6 months to 7 years [28]. The WeeFIM consists of three domains: cognition, self-care, and mobility. Each item is rated on a seven point scale ranging from 1: complete assistance to 7: total independence, which allows the calculation of a total functional independence score.

Child participants completed the Bayley Scales of Infant Development-II (Bayley-II) at 12 months and 30 months, which consists of two subscales, the Mental Index and the Motor Index [29]. The Bayley-II Mental Index was used in the present study to examine child cognitive development and includes an assessment of sensory/perceptual acuities, discriminations and responses; acquisition of object constancy; memory, learning, and problem solving; and vocalization. It also includes an assessment of the beginning of verbal communications, basis of abstract thinking, habituation and mental mapping.

Statistical Analyses

Maternal demographic covariates collected at baseline were used in this analysis. These included: age, completed years of schooling, marital status, household income, and sex of the child. The two randomized patient groups (prenatal surgery versus postnatal surgery) were compared by the BDI-II total score and aforementioned covariates of interest using Fisher's exact test for categorical variables and independent sample t-tests for continuous variables. Information regarding group differences in child outcomes has been previously described [24].

Multivariate regression models were used to examine how change in maternal depressive risk (BDI total score) between baseline and 30 months is associated with parenting stress (PSI-SF total score), child functional independence (WeeFIM total score), and child cognitive development (Bayley-II Mental Index). Linear regression analyses were performed first, with the demographic covariates considered for inclusion in the larger multivariate analysis if the simple linear model p-value was < 0.20. Using a backward-elimination process, the covariate with the highest p-value in each iteration was removed from the multivariate model until all remaining covariates maintained a p-value < 0.20. The type of surgery (prenatal versus postnatal) and change in BDI-II scores were always left in the multivariate model(s), as it was the primary covariate of interest for the present study. Data was analyzed using SAS version 9.4 (SAS Institute, Cary, NC).

Results

A total of 183 expectant mothers (92.8% White, non-Hispanic) were randomized, 91 in the prenatal surgery group and 92 in the postnatal surgery group. The baseline demographic variables are presented in Table 1. As published previously [24,25], the only significant difference between the surgery groups at baseline was female child sex (46.2% in the prenatal surgery group versus 62.0% in the postnatal surgery group, p=0.038). With regard to the BDI-II, the only significant difference in mean BDI-II total score between groups was at baseline prior to randomization, such that the prenatal group endorsed slightly higher mean depressive risk than those in the postnatal group (9.4 versus 7.5, p=0.014). There were

no significant differences in mean BDI-II score between groups at the 12 month or 30 month follow up evaluations (Table 2). Mean BDI-II scores remained low, in the minimal depressive risk range, across all time points for both groups. Only a small percentage of participants had higher scores in the moderate to severe depressive risk range in both groups (1.2%-4.5% across time points in the prenatal group; 1.1%-4.5% across time points in the postnatal group). No significant group differences were found in the percentage of participants with a score in the moderate to severe depressive risk category at any of the time points.

We examined change in mean BDI-II score from baseline to the 30 month follow up evaluation. The change between baseline and 30 months was negative such that mean depressive risk across both groups decreased slightly. A significantly greater decrease of 2.2 points on the mean BDI-II total score was found in mothers who had male versus female children (p=0.032), indicating mean depressive risk decreased more for mothers of male children. There were no other significant associations between demographic covariates and change in the mean BDI-II total score.

Multivariate regression analyses were used to examine how change in mean BDI-II scores between baseline and 30 months was associated with parenting stress on the PSI-SF total score at 30 months. Multivariate analyses examining the PSI-SF total score at 30 months indicated that both marital status (parameter estimate = −10.82, 95% CI (−20.63 to −1.01), p=0.031) and an increase in BDI-II scores between baseline and 30 months (parameter estimate [per 1 point increase] = 1.24, 95% CI (0.87 to 1.61), p<0.001) were significantly associated with parenting stress on the PSI-SF total score at 30 months. Mothers who were married demonstrated less parenting stress at 30 months by scoring 10.82 PSI-SF total score points less compared to mothers who were not married. When mean BDI-II scores increased by 1 point between baseline and 30 months, there was a corresponding 1.24 PSI-SF total score increase at 30 months, indicating that an increase in depressive risk was associated with higher parenting stress.

Additional multivariate regression analyses were used to examine how change in mean BDI-II scores between baseline and 30 months was associated with child functional independence on the WeeFIM total score and child cognitive development on the Bayley-II Mental Index score at 30 months. Analyses examining the WeeFIM total score at 30 months, indicated that the prenatal surgery group was a significant covariate (parameter estimate = 6.00, 95% CI (2.03 to 9.97, p=0.003). Participants who underwent prenatal surgery had better functional independence as measured on the WeeFIM. However, change in mean BDI-II total score between baseline and 30 months was not significantly associated with the WeeFIM total score at 30 months (p=0.75). Thus, change in maternal depressive risk was not associated with the child's functional independence at 30 months as rated on the WeeFIM. Multivariate analyses examining the Bayley-II Mental Index indicated that a 1 point increase on the BDI-II score between baseline and 30 months, corresponded with a 0.40 point Bayley-II Mental Index decrease at 30 months. Thus, when depressive risk increased between baseline and 30-months, child cognitive development at 30 months was lower. The following non-significant covariates were also included in the model: sex of the child (parameter estimate=−4.60, 95%

CI (−9.63 to 0.43), p=0.07) and number of years of maternal schooling (parameter estimate=1.24, 95% CI (−0.26 to 2.73), p=0.10).

Discussion/Conclusion

Using the MOMS Trial database, this study explored depressive risk among mothers of children with myelomeningocele prior to birth, and at 12 months and 30 months post birth. Mean scores on the BDI-II were in the minimal risk range at all three time points for mothers in both groups, suggesting that maternal depressive risk was low during the early childhood period. This is somewhat consistent with prior research suggesting that depressive risk is higher in parents of adolescents and young adults with myelomeningocele compared with rates of depressive symptoms in parents of children under 9 years of age [30]. A few studies have looked at depressive risk in mothers carrying fetuses with congenital anomalies, including spina bifida [15], as well as depressive symptoms in mothers of babies in the newborn intensive care unit [13, 14]. These populations demonstrate a heightened risk of perinatal depressive risk when compared to the national average. In general, most studies of depressive symptoms in parents of children with spina bifida span a wide age range (2 months to 18 years) and do not specifically target parents of young children [30]. To our knowledge, the present study is one of the first to report on maternal depressive risk exclusively during the early childhood period for children with myelomeningocele.

When comparing across groups of those who were randomized to prenatal versus postnatal myelomeningocele closure surgery, the only statistically significant group difference was the mean BDI-II score at baseline prior to participant randomization and surgery. Thus, maternal depressive risk does not appear to differ according to whether the child underwent prenatal versus postnatal surgery. Our results indicated that, as a whole, even though maternal depressive risk was minimal at baseline, mean scores in both groups continued to reflect a decrease in depressive risk during the first 30 months post birth. However, an increase in depressive risk was found to be associated with increased parenting stress at 30 months. In addition, maternal depressive risk was found to be lower for mothers of male children compared to female children. Furthermore, single mothers also reported more parenting stress which is consistent with other studies examining depressive risk and the relationship of single-parent status to parenting capacity [23, 31, 32].

Children who underwent prenatal surgical repair had better functional independence at 30 months, which has been previously reported [33]; however, change in maternal depressive risk was not associated with functional independence at 30 months. As a whole, child cognitive development at 30 months measured within the low average range across both groups. Increased maternal depressive risk during the first 30 months post birth was associated with slightly lower cognitive development (although still within the low average range). This is consistent with other studies that demonstrate maternal depressive symptoms to be associated with lower cognitive scores in infants and toddlers [34].

Although there were minimal outcome differences found between the prenatal versus postnatal surgical groups, a small percentage of mothers across both groups had scores in the moderate to severe depressive risk category. Thus, incorporating mental health screening

tools into both prenatal and postpartum clinical practice is warranted to help clinicians better identify the potential risks for psychological distress among parents of babies with spina bifida. Having a child with a chronic medical condition may increase the risks for depression and parenting stress over time [19–21]. Providers are in the unique position to identify families at risk and can help address anticipatory concerns, support parent/child attachment, secure additional social and psychological resources, and normalize the emotional distress of having a baby with a chronic medical condition [15, 18].

In summary, mean maternal depressive risk was found to be minimal during the first 30 months post birth regardless of whether the babies underwent prenatal or postnatal myelomeningocele closure surgery. However, a small percentage of mothers in both groups reported maternal depressive risk in the moderate to severe range, and an increase in maternal depressive risk during the first 30 months was associated with higher parental stress and slightly lower child cognitive development. Thus, it will be important to continue to monitor maternal depressive symptoms during this perinatal period and provide resources and interventions as needed.

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Table 1.

Demographic Variables by Treatment Group

Variables	Prenatal N=91	Postnatal N=92
Age at baseline	20.9% (N=19) <25 years 57.1% (N=52) 25–34 years 22.0% (N=20) 35+ years	16.3% (N=15) <25 years 71.7% (N=66) 25–34 years 12.0% (N=11) 35+ years
Years of schooling	Mean = 14.9 years (SD=1.7)	Mean = 14.9 years (SD=1.7)
Household Income (<50K)	36.9% (N=31)	29.2% (N=26)
Marriage status (married)	92.3% (N=84)	93.5% (N=86)
Sex of child (female)*	46.2% (N=42)	62.0% (N=57)

*Statistically significant difference as reported previously[24]

Table 2.

Beck Depression Inventory-II (BDI-II) Score across Time Points by Treatment Group (Standard Deviation)

BDI-II Time point	Prenatal	Postnatal	p-value
Mean BDI-II score at study enrollment (baseline) *	9.4 (5.1) N=91	7.5 (4.8) N=92	p=0.014
Percentage of scores in moderate to severe range	2.2%	1.2%	p=0.62
Mean BDI-II score at 12 months	5.4 (5.2) N=84	5.0 (5.7) N=88	p=0.60
Percentage of scores in moderate to severe range	1.2%	2.3%	p=1.00
Mean BDI-II score at 30 months	5.5 (6.4) N=88	5.5 (6.6) N=88	p=0.96
Percentage of scores in moderate to severe range	4.5%	4.5%	p=1.00

* Statistically significant difference