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Maternal Depression, Child Behavior, and Injury

Kieran Phelan, MD, MSc^{*,†,£}, Jane Khoury, PhD^{†,‡,£}, Harry Atherton, MS[†], and Robert S. Kahn, MD, MPH[†]

^{*}Division of Health Policy & Clinical Effectiveness, Cincinnati Children's Hospital Medical Center, University of Cincinnati

[†]General and Community Pediatrics, Cincinnati Children's Hospital Medical Center, University of Cincinnati

[‡]Center for Epidemiology and Biostatistics, Cincinnati Children's Hospital Medical Center, University of Cincinnati

[£]Center for Children's Environmental Health, Cincinnati Children's Hospital Medical Center, University of Cincinnati

Abstract

Background—Little data exists on the effect of maternal depression on child injury outcomes and mediators of this relationship.

Objective—Examine the relationship between mothers' depressive symptoms and medically attended injuries in their children and the potential mediating role of child behavior.

Design/Methods—A cohort of mother-child dyads from the National Longitudinal Study of Youth followed from 1992 to 1994. The primary exposure variable was maternal depressive symptoms as measured by the Center for Epidemiologic Studies – Depression Scale in 1992. Child behavior was assessed by the Behavior Problems Index externalizing subscale. Logistic regression was used to examine the relationship between depressive symptoms, child behavior, and injury reported in the year prior in 1994.

Results—94 medically attended injuries were reported in the 1106 children (8.5%); two-thirds sustained in the home environment. Maternal depressive symptoms significantly increased the risk of child injury; with injury risk increasing 4 percent for every 1-point increase in depressive symptoms (adjusted OR of 1.04, 95% CI 1.01, 1.08, p=0.02). Increasing maternal depressive symptoms also increased the risk of externalizing behavior problems (adjusted OR 1.06, 95% CI 1.03, 1.09), but externalizing behavior problems did not significantly mediate the relationship between maternal symptoms and child injury.

Conclusions—Increasing depressive symptoms in mothers was associated with an increased risk for child injury. Child behavior did not significantly mediate the association between maternal depressive symptoms and child injury in this cohort. Greater recognition, referral, and treatment of depressive symptoms in mothers may have effects on child behavior and injury risk.

Correspondence: Kieran J. Phelan, MD, MS, Assistant Professor of Pediatrics, Division of Health Policy & Clinical Effectiveness, Winslow Bldg., Rm. 5117, MLC 7014, Cincinnati Children's Hospital Medical Center, 3333 Burnet Avenue, Cincinnati, OH 45229-3039, kieran.phelan@cchmc.org, Phone: 513-636-3231 Fax: 513-636-7014.

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Keywords

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Children under the age of 6 years have the highest rates of residential injury.^{1, 2} Mothers with depressive symptoms consistent with clinical depression have been shown to be less likely to have functioning smoke detectors in their homes, to report use of child occupant restraint and electrical socket covers, and the back-to-sleep position for their infants compared with non-depressed mothers.^{3, 4} In another study, depressive symptoms in mothers of children 2 to 4 months of age were not associated with ED visits for injury 24 months later; in addition, the persistence of depressive symptoms in the mothers in this study was not associated with visits for well-child checks, acute care, or ED visits for care or injury in their children.⁵ Therefore, it remains unclear whether maternal depression is a risk factor for injury in their children.

Maternal depression has been associated with derangements in child temperament and behavior.⁶⁻¹¹ Child behavior, in turn, has been associated with an increased risk for injury.¹²⁻¹⁴ Although maternal depression has been associated with childhood injury, no studies have examined whether maternal depression may influence childhood injury through its impact on child behavior. Given the recent evidence linking maternal depressive symptoms to poor residential safety, parenting, and perturbations in child behavior, the early recognition and treatment of maternal depression may have important ramifications for the mother and her children.

The objective of this study was to examine the relationship between maternal depressive symptoms and injury outcomes in their children in a prospective cohort. We hypothesized that depressive symptoms in mothers of young children would be associated with increased injury risk. We further hypothesized that mothers' depressive symptoms would be associated with externalizing behaviors in their children, and that child behavior would partially mediate the relationship between maternal depressive symptoms and childhood injury.

Methods

Variables and dataset

A cohort of mother-child dyads was developed from the National Longitudinal Study of Youth (NLSY). The NLSY enrolled a cohort of teenage and young, adult women aged 14 to 22 years in 1979 with over-sampling of black, Hispanic, and low-income white women.¹⁵ The children of these women have been independently followed since 1986 with biennial assessment. As U.S. children less than 6 years have the highest rates of emergency visits for residential injury¹, we developed a cohort of women who had children from birth through 5 years of age by randomly selecting one child less than 6 years from each maternal record in 1992 and who were followed through 1994.

We used the outcome of an injury requiring medical attention in the prior 12-months, reported in the 1994 wave of the NLSY, as the primary outcome variable for this analysis. In order to reduce the possibility that a prior injury in a child may have contributed to depressive symptoms in the mother, we excluded from the cohort any child who, in 1992, had a medically attended injury in the prior year or any injury ever requiring a prior hospitalization.

Maternal depressive symptoms were assessed with the Center for Epidemiologic Studies Depression Scale (CES-D) in 1992.^{16, 17} The 20-item CES-D, ranks responses on a 3-point Likert scale resulting in scores ranging between 0 and 60 and rates the frequency with which respondents have felt depressed mood, feelings of helplessness, hopelessness, guilt and

worthlessness, loss of energy, and problems with sleep or appetite over a 1-week period. Higher scores reflect higher levels of depressive symptoms. The Cronbach's alpha for the mother's CES-D items in this cohort was good ($\alpha=0.71$) and comparable to that in other studies of maternal depressive effects on infants.¹⁸ Only 7-items of the full 20-item scale of the CES-D was administered again in 1994. However, using the full 20-item CES-D scale in 1992 we found that the 7-item score was highly correlated with the full, 20-item score (Pearson correlation=0.87). In order to examine the effect of more severe levels of symptoms, we examined the association of injury outcomes with CES-D scores consistent with clinical depression (CES-D \geq 16).^{19, 20} Persistence of depressive symptoms over time may have a greater effect than intermittent ones⁴; therefore, we also examined the relationship of depressive symptoms and reported child injury in mothers who scored in the highest quartile using the 7-item CES-D in both 1992 and 1994.

To validate the top quartile approach to symptom severity, we compared women who scored in the top quartile of the 7-item CES-D scale in 1992 to those scoring ≥ 16 on the 20-item version. Only 2 (1%) women in this top quartile of the 7-item scale (CES-D $>$ 7) in 1992 had 20-item scores less than 16, both of these scores were 14. The lowest 3 quartiles of the short form correctly classified 99.6% of those not depressed on the more widely recognized long form of the CES-D (20-item CES-D $<$ 16). Using the abbreviated, 7-item top quartile (mean 11.4, range 8-21) of the CES-D, 44% of those classified as clinically depressed (20-item score \geq 16) were captured in the top quartile of the 7-item short form. Therefore, the top-quartile of the 7-item CES-D in this cohort was a more specific subset of women with depressive symptoms consistent with clinical depression.

Maternal depression has been associated with a number of child behavior risks including attachment disorders in infants and toddlers and externalizing behavior disorders in older children.^{21, 22} The Behavior Problems Index (BPI), a 28-item survey included in the NLSY, measures the frequency, range, and type of childhood behavior problems in the 3 months prior but only for children age four years and over. Items were derived largely from the Achenbach Child Behavior Checklist (CBCL).²³ The externalizing subscale (BPIext) is an 18-item derived measure which reflects a child's tendency to externalize behaviors.¹⁵ The behaviors encompassed by the BPIext subscales ('impulsive, acts without thinking', 'restless overly active, cannot sit still', etc.) describe an active and intuitively at risk child.¹⁵ The Cronbach's alpha coefficient for the Behavior Problems Index variables in the cohort for these analyses was good (BPIext subscales $\alpha=0.87$). Higher scores represent a greater level of behavior problems. BPIext scores in 1994 were stratified for these analyses into quartiles from the lowest to highest reported degrees of externalizing behavior: lowest (83-91, 27%), second (92-100, 27%), third (101-111, 23%), and highest (112-163, 23%) quartile.

Other covariates considered for the models of maternal depressive symptoms on childhood injury were the location of injury, gender, race, number of siblings in the household, the child's birth order, maternal education, total household income, poverty status, and medical insurance status. Covariates were included in the models based on univariate and bivariate analyses and prior research. Variables with p-values $<$ 0.20 in bivariate analyses or those with prior research to support associations with childhood injury were examined for inclusion.²⁴ As it has been reported that boys and girls have different socialization as regards home safety^{25, 26} and that maternal depressive symptoms make act differentially on psychologic development of boys or girls, we tested the interaction of maternal depressive symptoms on gender and behavior in the models.

Statistical Analysis

Descriptive analyses and modeling of injury outcomes were undertaken using SAS® software.²⁷ Only maternal-child dyads with complete data for the desired descriptive and multi-variable

analyses were included (n=1106). Inclusion of the child behavior variable (BPIext) in the models reduced the 1994 sample by 324 records as the BPI is restricted to children ≥ 4 years. Chi-square tests were used to examine proportions of injured children by categorical covariates and two tailed t-tests were used for continuous covariates. Logistic regression was used to examine the association of maternal depressive symptoms with child injury controlling for covariates.

An approach outlined by Judd and Kenny was used to determine whether externalizing child behaviors mediated the effects of maternal depressive symptoms on child injury.²⁸ First, we examined the associations between maternal depressive symptoms (CES-D score) and the presumed mediator externalizing child behavior. Second, we examined the association between maternal depressive symptoms and injury. Third, we assessed how the relationship between maternal depressive symptoms and injury changed after adjusting for child behavior. The statistical analysis developed by Huang, et.al. for logistic models with binary outcomes (e.g. injured or not) was used to quantify the mediating effect of child behavior on the relationship between exposure to maternal depressive symptoms and injury outcomes in the children.²⁹ The changes in the unstandardized coefficients for maternal depressive symptoms with the mediator in and out of the models indicated the extent to which child externalizing behavior mediated the relationship between maternal depressive symptoms and injury.

Results

A total of 1106 mother-child dyads had complete data on the CES-D, injury outcomes, and the socio-demographic covariates. Half of the children in this cohort were males and almost eighty percent were from families with two or more children (see Table 1). A total of 94 children (8.5 %) in the cohort experienced a medically attended injury as reported by mothers in 1994. Almost two-thirds (n=66) of the injuries occurred in the home environment.

Potential covariates for models of childhood injury available within this cohort are displayed in Table 2. There was no difference in the proportion of injured and non-injured children by age (p=0.94) or gender (p=0.28), family income (p=0.25), poverty status (p=0.50), insurance coverage (p=0.83), maternal education (p=0.98), birth order (p=0.60), or number of siblings in the home (p=0.10). However, the proportion of injured children did vary significantly according to race (p=0.03).

The mean score of the 20-item CES-D in 1992 was 16.9 (s.d. 6.2). In bivariate analyses, there was a significant difference in mean CES-D scores between mothers of injured and non-injured children (18.2 ± 7.3 vs. 16.6 ± 5.7 , p=0.045). About 47 percent of mothers in the cohort had CES-D scores ≥ 16 in 1992. In bivariate analyses, the proportion of injured children was not significantly different in children of mothers with high depressive symptoms (CES-D ≥ 16) compared to children of mothers with lower scores (9.9% vs. 7.2%, p=0.11, Table 2). In multivariate analyses, children of mothers with depressive symptoms in 1992 were at an increased risk of injury in 1994, adjusting for covariates (Table 3, adjusted Odds Ratio (ORadj) 1.04, 95% Confidence limits (95%CI) 1.01, 1.08). Those with symptoms consistent with clinical depression (CES-D ≥ 16) were at greater risk, ORadj 1.38 (95%CI 0.89, 2.15), although this was not statistically significant. Furthermore, children of mothers with high and persistent depressive symptoms (highest quartile of 7-item CES-D in both 1992 and 1994) had greater than a two-fold increase in their risk of reported injury compared to children of mothers whose symptoms were not high in either year, ORadj 2.84, (95% CI 1.49, 5.41).

In logistic regression modeling we found a significant interaction between depression and gender (p=0.01). Therefore, we examined the effect of depressive symptoms on injury outcomes in boys- and girls-only cohorts (see Table 4). The risk of injury in boys of mothers

with depressive symptoms was higher than that for the full cohort, ORadj 1.08 (95% CI 1.04, 1.13). In contrast, there was not a significant association of maternal depressive symptoms and injury in girls, ORadj 0.98 (95% CI 0.93, 1.04).

If maternal depression and supervisory behavior are indeed linked to a young child's risk of injury, one might expect a lower or non-significant risk outside the home where exposure to parenting and supervision might be less likely (e.g. a public playground) compared to inside. There was a similar estimate of effect to the overall cohort for maternal depressive symptoms on residential injuries (N=62), ORadj 1.05 (95% CI 1.01, 1.10); however, there was not a significant effect in environments outside of the home (N=32), ORadj 1.03 (95% CI 0.97, 1.09) where exposure to maternal supervision is less likely.

The mean scores of the externalizing subscales of the BPI for the cohort greater than 4 years in 1994 (N=782) was 103.0 (s.d. 15.6, range 86 to 178). Children with scores in the highest quartile of the BPIext had significantly higher mean scores (107, s.d. 17.1 vs. 102, s.d. 14.6, $p=0.01$) and proportions of injured (14.7% vs. 6.2%, $p=0.0002$) compared with children in the lower quartiles.

The risk of a highest quartile BPIext score increased by 6 percent for each increase in maternal CES-D symptom score (Table 5). The risk was increased only for boys (ORadj 1.08, 95% CI 1.04, 1.13). Children of mothers with high depressive symptoms (CES-D \geq 16) were also at increased risk of top-quartile externalizing behaviors (ORadj 1.71, 95% CI 1.20, 2.42). Top-quartile externalizing behaviors were, in turn, a risk factor for injury compared to children in lower quartiles (ORadj 2.26, 95% CI 1.30, 3.96). However, children's externalizing behaviors did not appear to significantly mediate the effect of maternal depressive symptoms on childhood injury with only 4 percent (0.04, 95% CI -0.02, 0.09) of the effect operating through the BPIext. Externalizing behaviors (BPIext) were not a significant mediator in boys or girls when stratified by gender.

Discussion

Depressive symptoms in a cohort of mothers of young children in 1992 were significantly associated with an increased risk of subsequent medically attended injury. In this cohort the risk of reported injury increased by 4 percent for each 1-point increase in maternal depressive symptoms on the CES-D. Furthermore, high and persistent maternal depressive symptoms in this cohort of children less than 6 years of age were associated with an even greater increase in the risk of injury. Mechanisms that may explain the effect of increasing maternal depressive symptoms on childhood injury include changes in maternal supervisory behavior³⁰, ability to maintain the physical environment (increased clutter or other hazards)³¹⁻³³, or in perceptions of child behavior and injury risk.¹⁴

Although we did not find a significant mediating effect of child behavior on the relationship between maternal depressive symptoms and injury, depressive symptoms in this cohort did increase the risk of externalizing behaviors. This is consistent with several other reports.^{10, 34} It is likely that externalizing child behavior does have a role in increasing a child's injury risk^{35, 36}, however the BPIext may not be the ideal measure in young children under 6 years to explain the pathway from maternal depressive symptoms to childhood injury. In a recent study of the effects of maternal depressive symptoms on child behavior using the NLSY, it was found that maternal depressive symptoms had direct effects on child behavior in an older, 6-9 year-old cohort mediated through parenting behavior in white and Latino cohorts.³⁷

Although we found a significant interaction between depressive symptoms and child gender, we were limited in our power to explore the mediation effects of child behavior. Studies have shown that parents will socialize and supervise their children as regards injury risk behaviors

differentially by gender and this may partly explain the findings in this cohort.^{25, 26} Children, by 6 years of age, also display gender biases in perceptions of injury vulnerability which may lead to more or less injury risk behaviors.²⁵ Furthermore, although we controlled for socio-economic covariates, other unmeasured variables such as more specific measures of maternal supervisory beliefs and behavior and macro-level variables such as neighborhood social capital not present in the NLSY may have important effects on the relationship of maternal depressive symptoms and childhood injury.³⁸⁻⁴¹ Finally, we examined a young cohort of children from birth through 5 years and it is possible that mediation effects may be most pronounced in older cohorts.

We found that maternal depressive symptoms are associated with child behavior and injury in a young cohort of children in the NLSY. Thus, a reduction in symptoms or treatment of women with depressive symptoms might reduce the risk of injury in their children. In at least one controlled trial, treatment of maternal depression was associated with an 11 percent decrease in the rates of psychiatric and behavioral diagnoses in children of mothers whose depression remitted.⁴²

These results may not be generalizable to the larger US population as the sample population for these analyses was a subset of the larger NLSY cohort and weighted estimates were not developed. Our analyses were limited to depressive symptoms in 1992 and measures of externalizing behaviors and injury in 1994. To reduce the likelihood of reverse causation, i.e. - that prior injuries may have influenced maternal depressive symptoms we restricted analyses to children with no reported injuries in the 1992 survey. The NLSY oversampled from certain minority and low socioeconomic groups and almost half (47%) of mothers in this cohort of children reported depressive symptoms above the threshold for clinical depression (CES-D ≥ 16) consistent with several prior reports.^{5, 19, 20, 43} As the recall period for a medically-attended injury in the NLSY was 12-months, we may have underestimated the effect of depressive symptoms on injury through decreasing recall of child injury after 3 months.⁴⁴ A recent report has shown that maternal depression does not alter the recall of child health services usage.⁴⁵ The association of maternal depressive symptoms and medically attended injuries may be explained by depressed mother's inappropriate use of health services. While some studies may support this hypothesis^{46, 47}, a study by Watson and Kemper found no increase of scheduled or unscheduled health services usage by children of mothers with substance abuse, depression, or low social support.⁴⁸

Conclusions

Increasing depressive symptoms in mothers of young children in 1992 were significantly associated with the risk of an injury in 1994. Although depressive symptoms in mothers increased the risk of externalizing behaviors in boys, the effect of depressive symptoms of mothers on their children's risk of injury did not appear to be significantly mediated by child behavior in this cohort. Greater attention to the recognition, referral, and treatment of maternal depression may result in reductions in both child behavioral problems and injury.

Implications for Prevention

The recognition of depression in mothers of young children may have important ramifications for her child's development and injury risk. Primary care clinicians and pediatricians need to be able to screen for, recognize, and treat or refer for treatment mothers with depressive symptoms in order to reduce the risk of behavioral problems and injury in their children.

Key Points

- Maternal depressive symptoms were associated with injury outcomes in their children

- For each 1-point increase in maternal depressive symptoms as measured by the Center for Epidemiologic Studies - Depression scale (CES-D), there was a 4-percent increase in injury risk and an 6-percent increase in the risk of externalizing behavior problems in their children
- The recognition and treatment of depressive symptoms in mothers of young children may afford opportunities for the amelioration of behavior problems and medically-attended injuries in their children

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Table 1
Maternal and Child Characteristics, NLSY Cohort (N=1106), 1992-94

Characteristic	N	(%)
Injured in 1994		
Yes	94	8.5
No	1012	91.5
Place of Injury		
Home	62	66.0
Other	32	34.0
Gender		
M	553	50.0
F	553	50.0
Race		
White, non-hispanic	598	54.1
Black, non-hispanic	308	27.8
Hispanic	162	14.6
Other	38	3.4
Number of Siblings		
0	233	21.1
1	731	66.1
≥2	142	12.8
Birth Order of Child		
First	333	30.1
Second	419	37.9
Third or higher	354	32.0
Total Household Income		
<\$15,000	131	11.6
\$15,000-29,999	263	23.8
\$30,000-49,999	392	35.4
≥\$50,000	320	28.9
Below Poverty level		
Yes	188	18.8
No	811	81.2
Insurance Status (1990)		
Private	781	70.6
Medicaid	223	20.2
Other / Uninsured	102	9.2
Education		
<High school	203	18.4
High school	443	40.0
>High school	460	41.6

Table 2
Risk Factors for Children Reporting Injury in 1994

	N	Injured	%	P-value
Maternal Depressive Symptoms				
CES-D \geq 16 (categorical)	51		9.9	
CES-D <16	43		7.2	0.11
Child Gender				
Male	52		9.4	
Female	42		7.6	0.28
Child Race				
White, non-hispanic	64		10.7	
White, Hispanic	6		3.7	
African-American	22		7.1	0.02
Other	2		5.3	
Number of Siblings				
0	11		4.7	
1	71		9.7	0.06
\geq 2	12		8.4	
Total Household Income				
<\$15,000	12		9.2	
\$15,000-29,999	25		9.5	0.53
\$30,000-49,999	36		9.2	
\geq \$50,000	21		6.6	
Maternal Education				
<High school	18		8.9	
High school	36		8.1	0.93
>High school	40		8.7	
Insurance				
Private	68		8.7	
Medicaid	19		8.5	0.82
Other / uninsured	7		6.9	

Table 3
Logistic Regression Model of Maternal Depressive Symptoms Predicting Injury Outcomes 1994 (excluding Externalizing Child Behavior, BPIext)

Variable	Beta	SE	OR	95% CI	P-value
Depressive Symptoms (continuous CES-D score)					
Child Gender					
male	0.04	0.02	1.04	1.01, 1.08	0.03
female (reference)	0.13	0.11	1.29	0.84, 2.00	0.25
Family Income					
<\$15,000	0.20	0.27	1.88	0.80, 4.40	0.47
\$15,000-29,999	0.20	0.20	1.89	0.98, 3.66	0.30
\$30,000-49,999	0.03	0.12	1.59	0.90, 2.84	0.86
≥\$50,000 (reference)					
Family Size					
≥ 2 siblings	0.81	0.46	2.24	0.92, 5.47	0.08
1 sibling	0.85	0.34	2.36	1.20, 4.61	0.01
No siblings (reference)					
Maternal Education					
<High school	-0.04	0.20	0.83	0.42, 1.62	0.84
High school	-0.10	0.16	0.78	0.48, 1.28	0.50
>High school (reference)					
Child Race					
White, non-Hispanic	1.30	0.45	3.67	1.53, 8.80	0.004
Black	0.59	0.48	1.80	0.71, 4.61	0.22
Other	0.41	0.84	1.50	0.29, 8.87	0.63
White, Hispanic (reference)					
Child Age					
Years (each year)	-0.02	0.06	0.98	0.86, 1.12	0.74

Table 4
Adjusted Logistic Models of Maternal Depressive Symptoms Predicting Injury Outcomes including Externalizing Child Behavior (BPIext) for the Combined Cohort and by Gender

Dataset	Beta	SE	OR adj*	95%CI	P-value
Combined (N=782)	0.04	0.02	1.04	1.00, 1.09	0.049
Males Only (N=396)	0.09	0.03	1.10	1.04, 1.16	0.002
Females Only (N=386)	- 0.03	0.04	0.97	0.90, 1.04	0.37

* adjusted for demographic and SES covariates from table 2 and BPIext.

Table 5
Adjusted Logistic Models of Maternal Depressive Symptoms Predicting Externalizing Behaviors (BPIext) for Combined Cohort and by Gender

Dataset	Beta	SE	OR adj [*]	95%CI	P-value
Combined (N=782)	0.06	0.01	1.06	1.03, 1.09	0.0001
Males Only (N=396)	0.08	0.02	1.08	1.04, 1.13	0.0001
Females Only (N=386)	0.03	0.02	1.03	0.99, 1.08	0.13

* adjusted for demographic and SES covariates from table 2.