

# Association of Parent Workplace Injury With Emotional and Behavioral Problems in Children

Abay Asfaw, PhD, Steven L. Sauter, PhD, Naomi Swanson, PhD,  
Cheryl M. Beach, PhD, and Diana L. Sauter, PhD

**Objective:** Investigate associations between occupational injury to parents and the psychological well-being of their children. **Methods:** We used multiple logistic regression to examine effects of occupational injury to parents on measures of psychological well-being among their children using National Health Interview Survey data from 2012 through 2016. **Results:** Children of injured workers exhibited greater impairment than children of workers who had not sustained injuries for four of five measures of emotional and behavioral functioning that were hypothesized to differentiate these two child groups. A significant group difference was not observed for a sixth behavioral measure that was expected to be insensitive to parent occupational injury. **Conclusion:** Study findings heighten concern over downstream effects of occupational injury and signal need for more expansive investigation of these effects and mitigation strategies among children of injured workers.

**Keywords:** children, NHIS, parent workplace injury, psychological well-being

A small body of still formative research suggests that workplace injury may ripple through families to adversely affect the psychological well-being of children. The present study seeks to further investigate these effects as part of a larger program of study at the National Institute for Occupational Safety and Health (NIOSH) to better understand the burden of occupational injury. Research into the consequences of occupational injury and illness has focused heavily on their economic impacts, such as medical and indemnity costs borne by organizations, and worker's lost wages and benefits.<sup>1</sup> In a germinal paper, Dembe<sup>2</sup> advocated for a more expansive analysis that captures repercussions of occupational injury and illnesses beyond the worker or workplace—outcomes that are often hidden and difficult to measure and monetize, such as impacts on worker's families, coworkers, and others.

From the Centers for Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH), Economic Research and Support Office (ERSO), SW Washington DC (Dr Asfaw); Academy of Senior Professionals at Eckerd College (Dr Sauter); Centers for Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH), Division of Science Integration (DSI) (Dr Swanson); Cincinnati Center for Psychotherapy and Psychoanalysis (Dr Beach), Cincinnati, Ohio; Hamilton Co. Ohio Forest Hills School District (Dr Sauter) (Retired), Covington, Kentucky.

**Clinical significance:** Actions to manage the health effects of occupational injury need to extend beyond the injured worker to encompass family members with specific attention to the psychological well-being of the children of injured workers.

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Address correspondence to: Abay Asfaw, PhD, Centers for Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH), Economic Research and Support Office (ERSO), 395 E Street, SW Washington DC 20201 (AAsfaw@cdc.gov).

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## Learning Objectives

- Discuss previous reports on the potential association between occupational injury to parents and psychological well-being among their children.
- Summarize the new findings on the relationship between parent occupational injury and child emotional and behavioral outcomes, based on national survey data.
- Discuss the potential downstream effects on child mental health and the implications for care of injured workers.

In the last two decades some progress has been seen in study of these outcomes, especially family effects. Several studies have shown, for example, detrimental effects of occupational injury on marital or partner relationships, family structure and social roles, and family financial security, among other effects.<sup>3–10</sup> These observations support similar, earlier findings by Dawson<sup>11</sup> and Morse et al.<sup>12</sup> Recent investigations by NIOSH have added to this body of research. In one study, a 31% increase in hospitalization among spouses and children of injured workers was observed within 3 months post-injury.<sup>13</sup> A second study found a 15% increase in medical claims and a 34% increase in claim costs for musculoskeletal disorders among spouses and children of injured workers within 3 months post-injury.<sup>14</sup>

A subset of these family outcome studies converge in reporting a number of injury-related consequences with relevance specifically to the psychological well-being of children. Most prominently, they include degraded parent–child interactions, both physical and emotional, family instability, and need for children to assume expanded roles in support of the family and injured parent.<sup>3,8–10</sup> This literature, however, is constrained in several respects. Studies are few in number and qualitative research designs, such as descriptive or case studies, predominate. Not much is said about child end-outcomes, except for references to child withdrawal and elevated levels of child stress. And little attention is given at the conceptual level to ways occupational injury among parents might influence the psychological well-being of their children.

Further support for a causal link between occupational injury to parents and child psychological well-being can be drawn from two tangential bodies of research. First is the substantial literature on trauma-related psychopathology in parents and child mental health disorders.<sup>15</sup> The dominant focus in this literature is on parent post-traumatic stress disorder (PTSD) and child mental health in relation to highly traumatic parent exposures, such as war or terrorist events. Among these studies, Kishon et al.<sup>16</sup> have shown that children of first responders were at greater risk for a variety of psychiatric disorders, including depression, general anxiety disorder, and oppositional defiant disorders.

Secondly, support for a causal link between occupational injury to parents and child psychological well-being can be garnered from literature on the effects of job characteristics and work-family conflict on families, including children.<sup>17–21</sup> In a comprehensive review of child outcomes associated with work-family “experiences,” Cho and Ciancetta<sup>17</sup> describe studies showing relationships of

parent exposure to recognized job stressors (eg, low control, job insecurity, work pressure), job instability, and work-family conflict with emotional and behavioral problems among their children. By extension, occupation injury—seen as a class of occupational stressors—could then be expected to similarly threaten the psychological well-being of children when their parents are injured at work.

In terms of more fully understanding the burden of occupational injury and the value of prevention, the focus on child psychological well-being in relation to parent occupational injury is well-placed. Child mental health disorders are prevalent and costly, so even a modest injury effect could greatly exacerbate the burden. An estimated 13% to 20% of children and adolescents in the United States experience a mental health disorder each year.<sup>22–24</sup> And 50% to 75% of these children receive treatment or counseling from mental health professionals.<sup>23,25</sup> Early mental health disorders have a high degree of continuity into adulthood. Smith and Smith<sup>26</sup> reported up to a seven-fold risk for adult mental health disorders when a disorder was present in childhood or adolescence.

The socio-economic costs of early mental health disorders are remarkable. In 2015, disability adjusted life years (DALYS) arising from mental health disorders in children were second only to DALYS for childhood nutritional disorders in Europe and the Americas.<sup>27</sup> Annual medical treatment costs in the United States for child and adolescent mental health disorders averaged \$10.9 billion annually in the period 2009 to 2011.<sup>28</sup> All costs (inclusive of medical treatment, mental health service utilization, and parent lost productivity) were estimated at \$247 billion for the year 2007.<sup>29</sup> At the level of the individual, early mental health disorders have been associated with reduced educational attainment, subsequent job instability and dramatic lifetime earning losses, reduced chance of marriage or living with a partner in adulthood, and even with reduced longevity.<sup>26,30–32</sup>

In the present study, we sought to examine the relationship between occupational injury to parents and child psychological well-being in a more systematic and rigorous way than in prior works that have brought this relationship to light. We began by linking data on parent occupational injury and child emotional and behavioral outcomes from a representative national survey. Multiple logistic regression was then used to examine the relationship between parent occupational injury and these outcomes while controlling for factors that might otherwise confound this relationship. Five child emotional and behavioral outcomes that we hypothesized would be adversely affected in the presence of parent injury were selected for these analyses, as well as a sixth outcome expected to not discriminate between children with and without an injured parent.

## METHOD

### Data Source and Sample

The data source for this study is the National Health Interview Survey (NHIS). The NHIS is a cross-sectional household

interview that is conducted annually by the National Center for Health Statistics to provide nationally representative data on the health of the civilian, noninstitutionalized population of the United States. These data are publicly available at ([http://www.cdc.gov/nchs/nhis/about\\_nhis.htm](http://www.cdc.gov/nchs/nhis/about_nhis.htm)). We used the sample child, family, person, and injury episode files from the NHIS. The family and person files provide family socio-demographic, income, and health-related information. Additionally, every year from each household a sample child (when children are present) is randomly selected to collect detailed information on physical and mental health status, school-related data, and other information about the child. This information is collected by proxy from someone knowledgeable about the child's health—in most cases a parent. Information on incidents of work-related injury was obtained from the injury episode file. We linked the sample child file with the injury episode, person, and family files to obtain complete information about the sample child and their family with respect to study variables of interest.

To increase the sample size and reduce the standard error of estimates in our analyses, we combined 5 years of NHIS data (2012 to 2016). This yielded a total of 62,913 observations. We then selected the subsample of children between the ages of 6 and 17 ( $n = 42,007$ ) because some of the outcome (emotional and behavioral) measures of interest pertained to school activities. We also dropped 2806 observations with missing information on any of the study measures. This resulted in a final sample comprised of 39,201 children, 408 with a parent injured at work and 38,793 children with a parent not injured at work. This sample corresponds to a weighted US national population of 439,750 children ages 6 to 17 with a parent injured at work, and 45,586,592 children with a parent not injured at work.

## Measurement of Variables

### Parent Injury

Workplace injury was assessed as any medically consulted injury or poisoning episode that occurred while working at a paid job within a 3-month period preceding the survey. Parent injury cases were scored as “1” and non-cases as “0.”

### Emotional and Behavioral Outcome Measures

Data on the sample child emotional and behavioral status were obtained using the “Child Mental Health Brief Questionnaire.” This questionnaire is an element of the sample child file of the NHIS in which the proxy is asked to describe the child's mental health status. We examined six emotional and behavioral measures from this questionnaire for their sensitivity to parent injury (Table 1). Five of these measures (questions 1–5) were selected with the expectation they would be adversely affected by parent injury based upon clinical judgment of the authors, and extrapolation from the work-family literature<sup>17</sup> and the parent trauma and child psychopathology literature.<sup>15,16</sup> As a check on discriminant validity and risk of response bias, we also chose one measure (question 6) that we expected to be

**TABLE 1.** Questions Selected From NHIS as Measures of Child Emotional and Behavioral Status

Variable Name	Question
1. Worry	During the past 6 months (he/she) has many worries, often seems worried.
2. Depressed	During the past 6 months (he/she) is often unhappy, depressed, or tearful.
3. ECBR difficulties	Overall, do you think that [child name] has difficulties in any of the following areas: emotions, concentration, behavior, or being able to get along with other people?
4. Good attention span	During the past 6 months (he/she) has a good attention span/sees chores or homework through to the end.
5. Well-behaved	During the past 6 months (he/she) is generally well-behaved, usually does what adults request
6. Gets along with adults	During the past 6 months (he/she) gets along better with adults than with other children/youth.

ECBR, emotional, concentration, behavioral, and relationship.

**TABLE 2.** Distribution of Covariates by Children With and Without a Parent Injured at Work

	Non-Injured Parent	Injured Parent	Chi <sup>2</sup>
Number of sample children 6–17 years old without missing covariate data	38,793	408	
Sample child related variables			
Girls (%)	48.74	50.09	0.27
Age category (%)			0.16
6–7	16.47	16.09	
8–12	41.77	41.12	
13–17	41.76	42.79	
No health insurance (%)	3.47	3.70	0.06
ADD/ADHD (%)	11.24	16.37	9.77**
Respondent related variables			
Female (%)	70.70	68.35	0.99
Family related variables			
Marital status (%)			10.28*
Married	74.48	81.26	
Widowed, divorced, or separated	15.88	13.09	
Never married	9.65	5.64	
College (at least one of the parents had college education) (%)	72.60	68.51	3.11
Poverty category (%)			0.95
Poor	20.19	18.59	
Near poor	22.93	24.66	
Not poor	56.88	56.75	

ADD, attention deficit disorder; ADHD, attention deficit hyperactivity disorder.

\* $P < 0.05$ .\*\* $P < 0.01$ .

insensitive to parent injury. The recall period for the conditions referenced in these mental health questions was the last 6 months before the survey, except for question 3 for which the recall period was indefinite. Proxies answered “not true,” “somewhat true,” or “certainly true” to each question about the mental health of the sample child. To define cases and non-cases of emotional and behavioral problems, “somewhat true” and “certainly true” responses were scored as “1” and “not true” was scored as “0.”

We also created a composite emotional–behavioral measure based upon factor analysis of scores for the five emotional and behavioral measures that we expected to be sensitive to parent injury. This step was motivated by expectations of statistical interdependencies among these measures based upon evidence of comorbidity among the mental health conditions they referenced, or the possibility these conditions may represent manifestations of a common underlying disorder.<sup>31,33</sup> The composite measure was scored 1.0, (case, non-case) based upon mean split of the distribution of factor-analytically derived composite scores for each child.

### Covariates

We included several covariates related to the sample child and family that might influence the emotional and behavioral status of children. Sample child-related covariates were age group (6 to 7, 8 to 12, and 13 to 17 years), sex, and whether the sample child was covered by health insurance. A proxy was also asked whether parents have ever been told by a doctor or health professional that the child had attention deficit disorder (ADD) or attention deficit hyperactivity disorder (ADHD). Family-related covariates were marital status (widowed, divorced, or separated; never married; and married), poverty status (poor, near poor, and not poor), and college education (at least one of the parents had college education). Poverty status is based on family income and family size using the U.S. Census Bureau's poverty thresholds. “Poor” is defined as incomes below the poverty threshold; “near poor” as incomes of 100% to less than 200% of the poverty threshold; and “not poor” as incomes of 200% or more of the poverty threshold or greater. Because information about the sample child was provided by a proxy, we were motivated to include both proxy sex and relationship

to the sample child as covariates. However, we included only proxy sex as a covariate because 93% of respondents were parents (mother or father). Table 2 presents the distribution of covariates by children with and without an injured parent.

### Analyses

Our analyses used the “svyset” command of Stata® (StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP) that takes into account the multistage sampling procedure of the NHIS to generate nationally representative results.

We began with univariate analyses to take an initial look at the relationships of parent workplace injury with the six child emotional and behavioral measures. Multiple logistic regression was then used to separately predict cases for each of the emotional and behavioral measures while controlling for covariates. As a side analysis, these regressions were repeated, but without the covariate corresponding to whether the sample child was reported as having ADD or ADHD. This step was prompted by observation of an excess of ADD/ADHD reports in the child sample with injured parents (Table 2) in view of the potential for misattribution of childhood emotional or behavioral problems as ADD or ADHD. Were this to have occurred, controlling for the observed excess of ADD/ADHD reports in the child sample with injured parents would serve to underestimate the impact of parent injury on child emotional and behavioral outcomes. Finally, we regressed the composite emotional–behavioral measure on parent injury in the interest of gaining a consolidated picture of the impact of parent injury on the emotional and behavioral well-being of their children.

To avoid losing information, we used all children with and without injured parents in our analyses, even though the sample size for children without injured parents was substantially larger than the sample with an injured parent. Neither the chi-square test nor logistic regression requires equality of sample size,<sup>34,35</sup> and there were no differences in the percentage of missing data between the two groups of children. However, respecting any possible concerns about bias due to a large discrepancy in size between the two child samples, we repeated the logistic regressions for each emotional and behavioral outcome measure and the composite measure with a Monte Carlo

simulation using a smaller sample of children without an injured parent. For each of these analyses we used all children with injured parents and a randomly selected sample of children with a non-injured parent that was just five times the size of the sample of children with an injured parent ( $n = 2040$ ). Each of these analyses was repeated 100 times using a different randomly selected sample of children with a non-injured parent in each iteration. We then computed the overall average odds ratios and 95% confidence intervals.

## RESULTS

### Distribution of Covariates by Children With and Without an Injured Parent

As shown in Table 2, the two child samples were very similar with respect to most control measures. Regarding the child-related measures, except for the ADD/ADHD measure, the distribution of most covariates was nearly equivalent for both samples. Each sample was nearly evenly split by sex. The same was true for age distribution, with just over 16% of each sample in the 6 to 7-year age range, and just over 40% of both samples in both the 8 to 12 and 13 to 17 year age range. Just under 4% of children in each sample did not have health insurance. However, proxy respondents for the children with an injured parent were more likely to have been told the sample child had ADD or ADHD than were respondents for children without injured parents (16% vs 11%,  $\chi^2 = 9.7$ ,  $P \leq 0.05$ ).

Except for marital status of parents, there were no statistically significant differences in respondent and child family-related measures between the two groups of children. Marriage was less common among the parents of children without an injured parent than among children with injured parent (74% vs 81%,  $\chi^2 = 10.28$ ,  $P \leq 0.05$ ). Seventy-one percent of respondents in the non-injured parent sample were women, compared with 68% of respondents in the sample with injured parents. Similarly, poverty status did not distinguish the two samples, with 57% in each group reported as not poor, and group differences of only one to two percentage points in the near-poor and poor poverty categories. Lastly, the prevalence college education of at least one parent was also very similar in families with a non-injured and injured parent (73% and 69% respectively).

### Associations of Parent Injury With Child Emotional and Behavioral Outcomes—Univariate Analyses

Results of univariate analyses of group differences in prevalence of reporting of each of the six emotional and behavioral measures are presented in Table 3. As shown, children with injured parents fared more poorly than children of non-injured parents for four of the five emotional and behavioral measures where group

differences were expected. Children with an injured parent were significantly more likely to be reported to have many worries or to seem worried (worry) (34.8% vs 25.6%,  $\chi^2 = 16.37$ ,  $P \leq 0.01$ ), to be often unhappy, depressed or tearful (depressed) (17.2% vs 11.7%,  $\chi^2 = 10.36$ ,  $P \leq 0.05$ ), and to have emotional, concentration, behavioral, and relationship difficulties (ECBR difficulties) (31.6% vs 21.1%,  $\chi^2 = 24.15$ ,  $P \leq 0.01$ ). Similarly, children of injured parents were significantly less likely to be reported as having good attention span/sees homework or chores through to the end (good attention span) (81.6% vs 88.7%,  $\chi^2 = 18.49$ ,  $P \leq 0.01$ ). However, the frequency of reports that children were well-behaved and did what adults request (well-behaved) was equivalent for children with and without an injured parent (97.4% vs 97.2%). And last, the frequency of reports that children got along better with adults than children/youth (gets along with adults) in the last 6 months did not differentiate the two child samples (32.3% vs 31.9%).

### Associations of Parent Injury With Child Outcomes—Multivariable Analyses

All significant effects of parent injury status on child emotional and behavioral measures observed with univariate analysis were upheld with multivariable analysis. As shown in Table 4, after controlling for all covariates, the odds for reports of worry among children of injured parents were 51% greater than for children of non-injured parents. The odds for reports of depressed for children of an injured parent were elevated by almost the same amount (50%). An even greater increase (72%) in the odds for reports of ECBR difficulties was observed among children of an injured parent. Finally, the odds for reports of good attention span were reduced by 40% among children of injured parents.

Several of the child, respondent, and family covariates closely mirrored this pattern of effects (Table 4). ADD/ADHD, female respondent (proxy), widowed/divorced/separated marital status, and poverty status were associated at a statistically significant level with elevated odds for reports of child worry (except for poverty status), depressed, and ECBR difficulties, reduced odds for reports of good attention span, and also for well-behaved (except for widowed/divorced/separated marital status).

Significant but less patterned effects were seen for the remaining covariates. Odds ratios for child sex showed that, in comparison to boys, girls were favored with respect to reports of ECBR difficulties, good attention span, and well-behaved. But they were at increased risk for reports of worry and depressed. Older children similarly had elevated odds for reports of worry and depressed. Unlike widowed/divorced/separated marital status, never married parent status was associated with reduced odds for reports that children were depressed. Parent college education was associated with increased risk for reports of child worry and ECBR difficulties on one hand, but with elevated odds for reports of the positive measure well-behaved on the other hand. Lastly, several covariates (poor and near poor poverty status, never married, and widowed/divorced/separated marital status, ADD/ADHD, and older children) were associated with elevated odds for reports of gets along with adults.

### Injury Effects Without the ADD/ADHD Covariate

Table 5 shows the pattern and magnitude of injury effects on emotional and behavioral measures for the side analyses without control for reports of child ADD/ADHD. As seen by comparison of these data with effects when ADD/ADHD is controlled (Table 4, row 1), the pattern of effects was unchanged. Effects for worry, depressed, ECBR difficulties, and good attention span remained significant, and effects for well-behaved and gets along with adults remained insignificant. However, where significant, the odds for reporting an adverse effect were increased by up to 20% when we did not control for ADD/ADHD.

**TABLE 3.** Results of Univariate Analyses Comparing Prevalence of Reports of Emotional and Behavioral Outcomes for Children With and Without a Parent Injured at Work

Emotional and Behavioral Outcomes	Outcome Prevalence (%)		Chi <sup>2</sup>
	Non-Injured Parent	Injured Parent	
Worry	25.60	34.78	16.37**
Depressed	11.75	17.15	10.36*
ECBR difficulties	21.14	31.57	24.15**
Good attention span	88.66	81.57	18.49**
Well-behaved	97.16	97.39	0.07
Gets along with adults	31.94	32.26	0.02

ECBR, emotional, concentration, behavioral, and relationship.

\* $P < 0.05$ .

\*\* $P < 0.01$ .

**TABLE 4.** Results of Logistic Regressions for the Prediction of Reported Child Emotional and Behavioral Outcomes From Parent Injury at Work

Variable	OR (95% Confidence Interval)					
	Worry	Depressed	ECBR Difficulties	Good attention Span	Well-Behaved	Gets Along With Adult
Injured parent	1.51** (1.10–2.08)	1.50* (1.02–2.19)	1.72** (1.25–2.36)	0.60** (0.40–0.90)	1.16 (0.52–2.58)	0.98 (0.73–1.31)
Sample child related						
Girls	1.25** (1.17–1.33)	1.26** (1.15–1.37)	0.82** (0.76–0.88)	1.32** (1.20–1.45)	1.21* (1.02–1.43)	1.06 (1.00–1.13)
Age category						
6–7 (Ref.)						
8–12	1.46** (1.32–1.62)	1.68** (1.46–1.93)	1.03 (0.93–1.14)	1.14 (1.00–1.30)	1.25 (0.99–1.58)	1.23* (1.13–1.34)
13–17	1.70** (1.54–1.88)	2.06** (1.79–2.37)	0.89* (0.80–0.99)	1.11 (0.97–1.27)	1.10 (0.87–1.37)	1.66** (1.52–1.81)
No health insurance	1.03 (0.88–1.22)	0.96 (0.77–1.20)	1.14 (0.94–1.39)	1.02 (0.80–1.30)	0.69 (0.46–1.03)	0.96 (0.82–1.11)
ADD/ADHD	3.07** (2.81–3.36)	3.42** (3.08–3.79)	14.76** (13.38–16.28)	0.12** (0.11–0.14)	0.21** (0.18–0.25)	1.86* (1.70–2.03)
Respondent related						
Female	1.39** (1.29–1.49)	1.38** (1.25–1.53)	1.53** (1.40–1.67)	0.83** (0.75–0.92)	0.76** (0.62–0.94)	1.00 (0.94–1.06)
Family related						
Marital status						
Married (Ref.)						
Widowed, divorced, or separated	1.37** (1.26–1.49)	1.35** (1.21–1.50)	1.39** (1.26–1.53)	0.86** (0.77–0.97)	0.83 (0.69–1.01)	1.19** (1.10–1.28)
Never married	0.89* (0.80–0.99)	0.98 (0.85–1.12)	1.32** (1.17–1.49)	0.97 (0.84–1.13)	0.87 (0.69–1.10)	1.13** (1.03–1.25)
College education	1.25** (1.16–1.35)	0.96 (0.87–1.06)	1.22** (1.12–1.33)	1.11 (1.00–1.23)	1.31** (1.10–1.56)	0.91** (0.85–0.98)
Poverty category						
Not poor (Ref.)						
Near poor	0.92* (0.85–1.00)	1.38** (1.24–1.55)	1.22** (1.11–1.35)	0.68** (0.61–0.77)	0.56** (0.46–0.72)	1.26** (1.17–1.35)
Poor	1.04 (0.95–1.14)	1.63** (1.45–1.83)	1.37** (1.24–1.52)	0.62** (0.55–0.71)	0.43** (0.35–0.54)	1.35** (1.24–1.47)
Number of obs.	39,053	39,058	39,070	39,061	39,070	38,902

ADD, attention deficit disorder; ADHD, attention deficit hyperactivity disorder; ECBR, emotional, concentration, behavioral, and relationship.

\* $P < 0.05$ .\*\* $P < 0.01$ .

**TABLE 5.** Logistic Regression Results for the Prediction of Reported Child Emotional and Behavioral Outcomes from Parent Injury at Work Controlling for all Covariates Except Child ADD/ADHD

Outcomes	OR	95% Confidence Interval
Worry	1.60**	(1.19–2.14)
Depressed	1.60**	(1.12–2.28)
ECBR difficulties	1.84**	(1.35–2.50)
Good attention span	0.55**	(0.37–0.82)
Well-behaved	1.05	(0.47–2.38)
Gets along with adults	1.02	(0.75–1.38)

ADD, attention deficit disorder; ADHD, attention deficit hyperactivity disorder; ECBR, emotional, concentration, behavioral, and relationship.

\*\* $P < 0.01$ .

### Injury Effects—Composite Measure

As explained, significant parent injury effects were observed for four of the five emotional and behavioral measures expected to differentiate children with and without injured parents (worry, depression, good attention span, ECBR difficulties). Except for the association of worry with good attention span (polychoric  $r = 0.29$ ), moderate to strong associations (polychoric  $r = 0.36$  to  $-0.74$ , absolute values) were observed among these four measures. Although the injury effect for well-behaved was not significant, this measure had moderate to strong associations with the depression, good attention span, and ECBR difficulties measures (polychoric  $r = 0.37$  to  $-0.60$ , absolute values). These observations lent support to our rationale to subject these five emotional and behavioral measures to factor analysis to derive a composite emotional-behavioral measure.

Factor analysis of these five indicators (worry, depression, ECBR difficulties, good attention span, and well-behaved) yielded a single factor with an eigenvalue greater than one ( $\lambda = 2.51$ ). No interpretable, additional factors could be discerned with or without rotation. As described, a dummy variable was then computed based upon a mean split of the weighted sum of the standardized versions of the five measures. (Note: The mean split resulted in a case prevalence of 29%. A median split would have produced an equal number of cases and non-cases for the composite measure, which would represent an exaggerated case prevalence [50%] judging by the percentage of cases for the five children outcome measures we expected to be sensitive to parent injury [Table 3]).

Effects of parent injury and all covariates on the composite measure are shown in Table 6. These effects can be seen to align well with the overall trend witnessed for the five emotional and behavioral measures for which parent injury effects were anticipated (Table 4, row 1). The effect of parent injury remained strong and significant, and older children, ADD/ADHD, female respondent, widowed/divorced/separated marital status, college education, and poverty were similarly associated with significantly increased risk in relation to the composite measure.

However, whereas girls were associated with reduced odds for several outcomes in the individual analyses (Table 4), the overall effect for the composite measure was a significant, increased risk.

### Injury Effects With Monte Carlo Simulations

Table 7 shows the effects of parent injury for all six emotional and behavioral measures and the composite emotional-behavioral measure with 100 iterations of the multiple logistic regression analysis for each of these outcomes, each with a different, randomly selected sample of children without injured parents. As seen, the resulting odds ratios for injury effects for the six emotional and behavioral measures are nearly identical in magnitude to the odds

**TABLE 6.** Logistic Regression Results for Prediction of the Composite Child Emotional and Behavioral Outcome Measure From Parent Injury at Work

	OR 95% Confidence Interval
Injured parent	1.55** (1.13–2.12)
Sample child related	
Girls	1.27** (1.19–1.35)
Age category	
6–7 (Ref.)	
8–12	1.46** (1.33–1.61)
13–17	1.70** (1.55–1.87)
No health insurance	1.02 (0.87–1.20)
ADD/ADHD	3.21** (2.94–3.51)
Respondent related	
Female	1.36** (1.27–1.46)
Family related	
Marital status	
Married (Ref.)	
Widowed, divorced, or separated	1.33** (1.23–1.44)
Never married	0.92 (0.83–1.02)
College education	1.18** (1.09–1.27)
Poverty category	
Not poor (Ref.)	
Poor	1.13** (1.03–1.23)
Near poor	0.99 (0.92–1.08)
Number of obs.	39,039

ADD, attention deficit disorder; ADHD, attention deficit hyperactivity disorder.

\*\* $P < 0.01$ .

ratios for injury effects for these measures shown in Table 4. Similarly, the odds ratio for the injury effect for the composite emotional-behavioral measure is equivalent to the odds ratio for the composite measure in Table 6. Odds ratios for each measure across the 100 iterations were remarkably stable. In no instance did standard deviations of resultant odds ratios for each measure exceed 0.1.

## DISCUSSION

### Parent Workplace Injury, Child Outcomes, Socio-Economic Implications

The present study builds upon evidence of child stress and troubled parent-child dynamics in a small body of mainly qualitative investigations of family consequences of occupational injury. Our analyses drew upon nationally representative data on occupational

**TABLE 7.** Monte Carlo Logistic Regression Results for the Prediction of Reports of Child Emotional and Behavioral Outcomes From Parent Injury at Work Controlling for all Covariates

Outcomes	OR (95% Confidence Interval)
Worry	1.52* (1.08–2.13)
Depressed	1.54* (1.01–2.32)
ECBR difficulties	1.78** (1.24–2.57)
Good attention span	0.61* (0.39–0.96)
Well-behaved	1.24 (0.53–2.89)
Gets along with adults	0.99 (0.72–1.36)
Composite emotional/behavioral outcome	1.55* (1.10–2.16)

ECBR, emotional, concentration, behavioral, and relationship.

\* $P < 0.05$ .

\*\* $P < 0.01$ .

**TABLE 8.** Prevalence of Reports of Child Emotional and Behavioral Problems Among Children of Parents Injured at Work by Injury Status of Respondents

Outcomes	Injured Parent was Not the Respondent (%)	Injured Parent was the Respondent (%)	Chi <sup>2</sup>
Worry	32.69	36.94	0.81
Depressed	19.80	14.41	2.08
ECBR difficulties	31.54	31.61	0.01
Good attention span	80.94	82.20	0.11
Well-behaved	97.77	96.99	0.24
Gets along with adults	31.83	32.70	0.04

ECBR, emotional, concentration, behavioral, and relationship.

injury and child psychological well-being to more methodically investigate risks for emotional and behavioral conditions among children of parents who have suffered workplace injuries. Study findings provide what appears to be the first systematic evidence that effects of occupational injury can ripple through families to adversely influence the psychological well-being of children.

As hypothesized, the prevalence of reporting frequent worry (worry), depressive symptoms (depressed), and the combination outcome corresponding to emotional/concentration/behavioral/relational difficulties (ECBR difficulties) was significantly greater among children of parents injured at work than among children of non-injured parents. Consistent with this pattern of adverse effects, significant reductions in reports of good attention span (good attention span) were also observed among children with parents injured at work. As expected, no parent injury effect was observed for the gets along with adults measure, adding discriminant validity to this set of findings. All these injury effects held in multivariable analyses that included numerous covariates with known associations with child emotional and behavioral outcomes. The parent injury effect held also for a composite emotional/behavioral outcome measure comprised of the worry, depressed, ECBR difficulties, and good attention span measures. A fifth outcome (well-behaved) that was also expected to suffer among children with injured parents, proved non-significant in both univariate and multivariable analyses.

Various circumstances may underlie the unexpected null effect for the well-behaved measure. Parent injury may not have been sufficiently salient to provoke oppositional or defiant behavior among their children. Also, it is striking that less than 3% of the children with and without injured parents were reported as behaving poorly. This raises the possibility that the well-behaved measure might not have been sufficiently sensitive to the effects of parent injury on child conduct, resulting in too little variation in this measure for robust analysis. It is plausible, too, that injury to parents may have elicited an empathetic response among some children, resulting in more considerate, obedient, and cooperative behaviors that served to offset any effect of parent injury on child poor behavior.

There is some possibility the observed effects of parent workplace injury underestimate the true injury effect sizes by virtue of statistical control for reports of child ADD/ADHD in our statistical models. As a neurologic condition, ADD/ADHD was treated as a covariate amidst concern that its behavioral manifestations might be misinterpreted as parent injury-related outcomes. Indeed, Diagnostic and Statistical Manual of Mental Disorders (DSM-5) criteria for ADHD overlay closely with two of the four emotional and behavioral outcomes (ECBR difficulties and good attention span) that were found to differentiate children with and without parents injured at work. Controlling for ADD/ADHD would obviate this problem. However, it is plausible that the excess of ADD/ADHD reports in the injured parent child group reflects injury-induced exacerbation of child ADD/ADHD manifestations.

Kishon et al<sup>16</sup> reported, for example, that child ADHD expressions were amplified in the presence of parent PTSD. Control for ADD/ADHD under these circumstances would serve to deflate effect sizes for parent injury. In this regard, it is notable that injury effects sizes in the present analyses increased by up to 20% when we did not control for ADD/ADHD.

The discrepancy in look-back periods for recording of child emotional and behavioral problems (up to 6 months presurvey for all but one measure) and parent injury (up to 3 months presurvey) may also have contributed to an underestimate of parent injury effects. Because the injury look-back period was only 3 months presurvey, child emotional and behavioral problems associated with a parent injury event in months 4 to 6 presurvey would not have been picked up as parent injury-related and recorded instead as problems associated with non-injured parents, thereby reducing the differential in emotional and behavioral problems between children with and without injured parents.

A potential threat to attribution of observed adverse child emotional and behavioral conditions to parent workplace injury is the possibility that injured parents may project their own injury-related emotional and behavioral problems onto their children. However, as shown in Table 8, post-hoc analyses revealed no differences in the prevalence of reports of these outcomes between injured and non-injured parent respondents. Additionally, the study cannot rule out the possibility of reverse causation owing to its cross-sectional nature. Consistent with resource drain theory,<sup>36</sup> it is conceivable that the demands of caring for children with behavioral and emotional problems may deplete physical and psychological resources essential for safe job performance leading, in turn, to workplace accidents. While this pathway cannot be discounted, we are unaware of reports that have investigated a link from child well-being to parent occupational injury. However, a handful of studies are found in which stressful life circumstances among adults preceded occupational accidents.<sup>37,38</sup>

Altogether, the present observations strongly suggest that parent occupational injury presents a measurable risk to the psychological well-being of their children. Our findings support and amplify earlier, more qualitative observations of adverse outcomes among children of parents injured at work,<sup>3,8–10</sup> and they parallel observations of mood disorders among children of parents suffering PTSD incident to highly traumatic occupational and non-occupational exposures.<sup>15,16</sup> These findings follow, too, from the considerable literature on parent work-family experiences (short of injury) and adverse emotional and behavioral outcomes among their children.<sup>17</sup>

Lastly, as previously detailed, poor mental health in childhood can have important socio-economic consequences involving substantial health care costs, lower educational attainment of children and adolescents, increased risk of adult mental health disorders and lifetime earnings losses. To better appreciate effects observed in the present investigation, we selected two outcomes (worry and depressed) that correspond closely with DSM-5 anxiety and

depressive disorders, and we estimated the excess prevalence of these outcomes among children 6 to 17 years of age in the US population. A dummy variable corresponding to cases or non-cases worry and/or depressed reports (worry/depressed) in the present sample was created and regressed on the parent injury variable and all covariates to determine the marginal effect of parent injury on this measure. Applying this effect to the weighted child population with injured parents at the time of data collection ( $N = 439,750$ ) yielded a 6-month count of 47,185 cases of child worry/depressed, or an annualized count of 94,370 cases, associated with parent occupational injury. In the United States, annual treatment costs for child psychological disorders average \$2840 per child in 2020 dollars (adjusted for inflation from Davis<sup>28</sup>). It is unclear what proportion of the population excess of children with parent injury-related worry/depressed cases would receive treatment since these cases do not necessarily equate to diagnosed psychological disorders. However, based upon the sizable excess of worry/depressed cases and treatment costs, treatment of even a modest share of these cases would incur a substantial economic burden.

### Covariate Effects

Were covariate effects to have varied widely from patterns documented in extant literature, the credibility of effects seen for parent injury might be questioned as well. However, this was not the case. Covariate effects demonstrate strong conformance with effects illustrated in prior research on the associations of these or similar variables with the mental health of children and adolescents. Reports of worry and depressed, for example, were found to be more prevalent for girls, similar to observations of increased anxiety, depression, and emotional problems among girls in several earlier investigations.<sup>3,39,40</sup> Reports of well-behaved were also more prevalent and ECBR difficulties (having behavioral components) were less prevalent among girls in the present data, which aligns with prior observations of fewer behavioral problems and conduct disorders among girls.<sup>33,39,41</sup>

Similarly, findings that reports of worry and depression were more prevalent among older children runs parallel to the age-related trend for anxiety and depression that is recurrent in the literature.<sup>25,33,40,41</sup> In the same way, findings of unfavorable effects for most of the present emotional and behavioral outcome measures when the parents of children are widowed, divorced, or separated, or unmarried reflect the pattern seen in several prior studies.<sup>25,39,41</sup> More frequent reports of child depression and ECBR difficulties in impoverished families in the present study also find parallels in the prior investigations,<sup>33,41</sup> and we further observed adverse effects of poverty for good attention span and well-behaved, with the latter having been reported previously by Perou et al.<sup>33</sup> Lastly, we observed no effect of family insurance coverage (but less than 4% of our sample was uninsured) and a mixed effect of parent educational attainment. College education was associated with increased reports of well-behaved, but also increased reports of worry and ECBR difficulties. This latter observation might be explainable by increased attentiveness to child moods among more highly educated parents, but contrasts with associations between level of parent education and diagnosed child anxiety in prior studies.<sup>25,33</sup> In sum, observations that the present covariates overwhelmingly behave in a predictable way with respect to child outcome measures serves to increase confidence in the credibility of observed parent injury effects on these measures.

### Mechanisms

As noted, little attention has been given in the still sparse literature on parent occupational injury and child outcomes to conceptual frameworks to account for this relationship. Beyond the prevention of parent injury in the first instance, insight to mechanisms underlying this relationship could more fully inform points of intervention to reduce the risks of occupational injury to children of injured

workers. Although it was not within the capacity of the present study to investigate mechanisms for parent injury effects, inferences regarding these mechanisms can be drawn from accumulating work-family research on child well-being.<sup>17–21</sup> Following from a synthesis of this literature, Cho and Ciangetta<sup>17</sup> introduced a conceptual model based upon ecological systems theory<sup>42</sup> that depicts pathways from parent work-family experiences to child outcomes. As described by Cho and Ciangetta,<sup>17</sup> parent work-family experiences shape parent outcomes that are manifest in the home environment (eg, parent affective states, physical and psychological health and availability to their children, family resources, etc). In turn, these parent outcomes influence child outcomes via parent–child interactions, such as parenting behavior, engagement in joint activities, and the quality of parent–child relationships. Many of these same processes are also acknowledged in studies of trauma-related psychopathology in parents and child psychological disorders.<sup>15</sup>

The Cho and Ciangetta<sup>16</sup> model holds promise for understanding mechanisms underlying the effects of parent occupational injury on child outcomes because many of the observations from this literature readily map to the Ciangetta<sup>16</sup> model. Figure 1 shows the core framework of the Cho and Ciangetta<sup>16</sup> model (parent work-family experiences leading to parent outcomes which, in turn, shape parent–child interactions and child outcomes), but with (our) addition of occupational injury as a driver of parent outcomes. Effects appearing in the original Cho and Ciangetta<sup>17</sup> model are denoted by citation “16” in Fig. 1. All other citations appearing in Fig. 1 denote model effects that are imported (ie, mapped to the model) from the occupational injury and family outcomes literature.

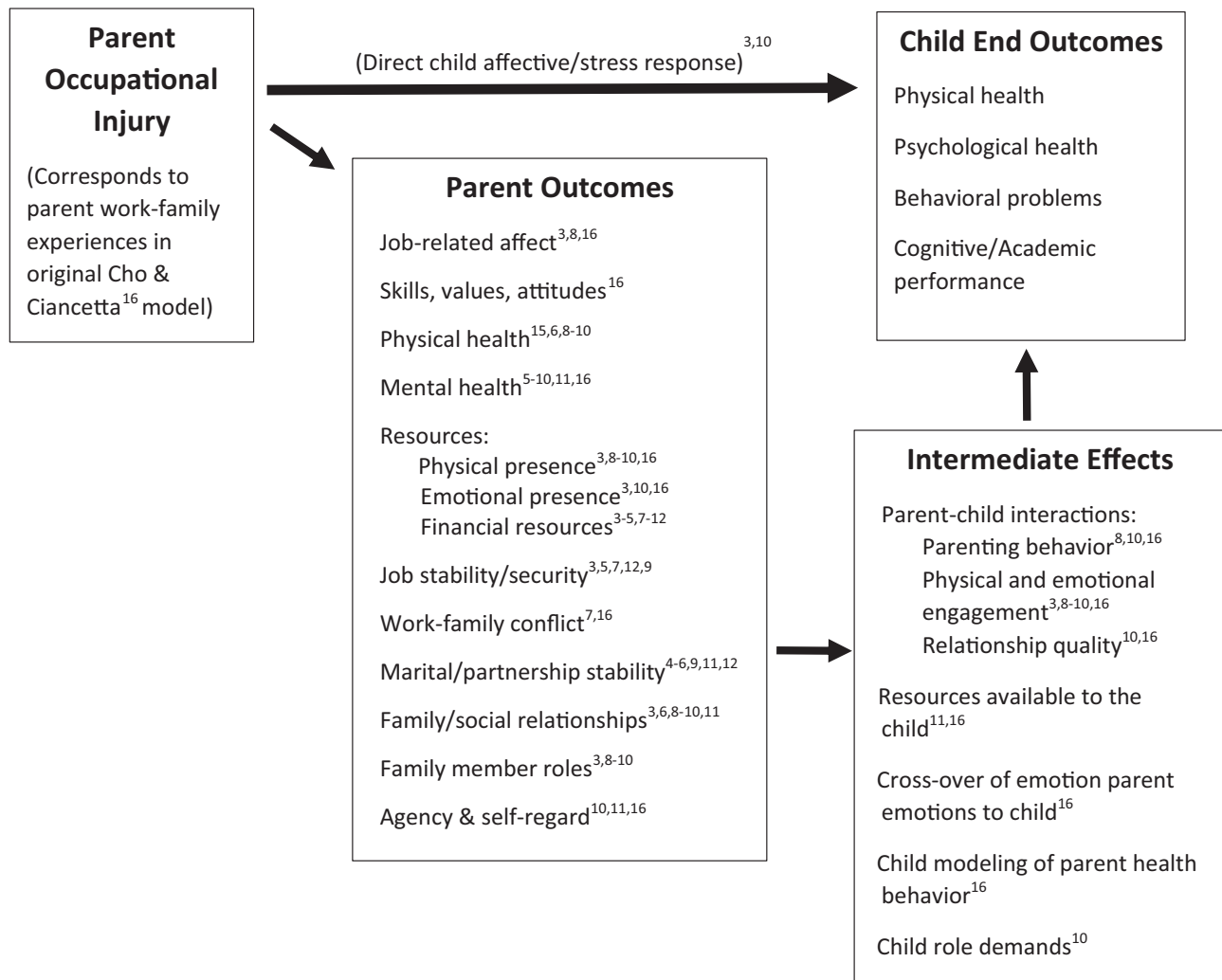
Referring to Fig. 1, effects observed in the occupational injury and family outcome literature are seen to match well with effects denoted in the Cho and Ciangetta<sup>16</sup> model. Illustrating this congruence, the occupational health and family outcome literature abounds with reports of mental health conditions among injured workers, including depression, anger, suicidal ideation, and loss of sense of self-worth, identity, and adequacy.<sup>5,6,8–11</sup> Understandably, physical health disorders such as chronic pain, restriction in activities of daily living, and disability are also prevalent among injured workers.<sup>5,8,10,12</sup> In turn, physical and mental health conditions among injured workers are associated with increased risk of marital and family discord, disruption of social relationships and withdrawal from community, friends and family,<sup>2–6,8–12</sup> including physical and emotional disengagement from children.<sup>3,9,10</sup> Studies of occupation injury and family outcomes also report effects on family roles, including a shift of domestic responsibilities to spouses or partners of injured workers<sup>3,8,9</sup> and to their children,<sup>10,11</sup> leading to strained parent–child relationships.<sup>10</sup>

Figure 1 also depicts effects from the occupational injury and family outcome literature that are not represented in the Cho and Ciangetta<sup>16</sup> model but, nevertheless, fit comfortably within this framework. The occupational injury literature, for example, reports evidence of job insecurity and financial hardship among injured workers, leading in turn to withholding of financial support for child education.<sup>11</sup> Additionally, the occupational injury literature provides evidence of a direct, stress-related, affective response of children to a parent injury event that is not mediated by parent outcomes.<sup>3,10</sup>

Lastly, Fig. 1 shows plausible mechanisms for child effects of parent injury that derive from the work-family and child outcome literature, such as contagion (cross-over) of parent emotional distress to children, but have yet to be explicitly acknowledged in the occupational injury literature.

In sum, the convergence of parent and child effects in the work-family and the occupation injury literature points to the Cho and Ciangetta<sup>17</sup> model as a useful vehicle for understanding mechanisms underlying the relationship between parent occupational injury and child outcomes, and also for identifying leverage points to mitigate effects of parent injury on child well-being.





**FIGURE 1.** Possible pathways from parent occupational injury to child emotional and behavioral outcomes. Adapted from the Cho and Ciancetta<sup>17</sup> model of work-family experiences and child outcomes. Superscript '16' denotes model elements in the original Cho and Ciancetta<sup>16</sup> model. All other superscripts refer to sources for model elements imported from the occupational injury and family outcome literature.

### Limitations and Strengths

It is reasonable to expect that parent injury characteristics, such as injury severity, would influence the nature and magnitude of effects on child outcome measures. However, injury characteristics were unavailable in the NHIS data set and, therefore, could not be investigated. Similarly, larger injury effect sizes might be expected in the event of injury to both parents. However, too few cases of dual injury were observed in the study sample (less than 0.5%) to investigate this expectation. As noted previously, the cross-sectional nature of this study leaves open the possibility that parent injury risk was influenced by family dysregulation associated with child emotional and behavior problems. While theoretically plausible, scant data that could apply to this proposition are found in the literature.

Perhaps the most visible study limitation is the discrepancy in look-back periods for reporting of child emotional and behavioral problems (6 months presurvey for most measures) versus parent injury (3 months presurvey). As discussed, child emotional and behavioral problems associated with a parent injury during months 4 to 6 of the 6-month look-back for these problems would have been recorded among the sample of children without injured parents since the look-back for parent injury was only 3 months. In

this event, observed effect sizes for parent injury in the present study would understate their true magnitude. Further, it is likely that some child emotional and behavioral problems associated with parent injury went undetected due to latency between parent injury and the emergence of these problems, especially in the case of injuries that closely preceded the survey. Were this to have occurred, again, the effect would be an underestimate of effect sizes for parent injury.

Finally, a possible competing explanation for observed injury effects is that injured parents may have experienced inferior or more stressful working conditions than did parents who were not injured at work, and that these conditions were responsible in full or part for the observed child outcomes. Because job characteristics could not be measured, we cannot fully rule out this possibility. However, it is notable in this regard that our study does control for conditions associated with socioeconomic status (SES). This includes family poverty status (which did not differentiate families with and without an injured parent), and parent college education or not (which also did not differentiate families with and without an injured parent). Research shows that job characteristics that threaten the physical and mental health of workers, such as dirty working conditions, repetitive tasks, and lack of control over working hours are stratified

by SES.<sup>43</sup> Thus, by controlling for two major aspects of SES (poverty status and education), we are confident that differences in the psychological well-being of children with and without injured parents are largely free of any effects associated with differences in job characteristics of parents who are injured or not at work.

Against these limitations are study strengths associated with a well-established methodology for data collection from a large nationally representative sample of working parents and their children. Analyses controlled for key conditions known to affect the psychological well-being of children, and the study design incorporated a child outcome measures for which null effects were expected and observed, adding to the discriminant validity of our findings.

## CONCLUSIONS AND FUTURE DIRECTIONS

The present findings strongly suggest that occupational injury to parents poses a threat to the psychological well-being of their children and, by extrapolation from longitudinal study of children with mental health problems, to their quality of life in adulthood. As a tangible example of this threat, present data indicate that nearly 100,000 children in the United States may be afflicted with symptoms of anxiety or depression that are associated with occupational injury of their parents in any 12-month period. Our results corroborate earlier qualitative observations of child emotional and behavioral problems in the presence of parent occupational injury, and they add weight to Dembe's<sup>2</sup> appeal for investigations to look beyond the worker and the workplace to more fully comprehend the burden of occupational injury. Perhaps most important, however, results of the present study invite further investigation of child well-being in relation to parent occupational injury—a topic that has received only incidental attention in occupational injury research and seems not to have been broached in work-family studies in occupational health psychology. Research is needed to more fully delineate the effects of parent occupational injury on child well-being and their socio-economic consequences, and to identify ways to mitigate these effects.

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