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## Paid family leave's effect on hospital admissions for pediatric abusive head trauma

Joanne Klevens, MD, PhD, Feijun Luo, PhD, Likang Xu, MD, MS, Cora Peterson, PhD, and Natasha E. Lutzman, PhD

National Center for Injury Prevention and Control, Centers for Disease Control and Prevention (CDC), Atlanta, GA, USA

### Abstract

Pediatric abusive head trauma (AHT) is a leading cause of fatal child maltreatment among young children. Current prevention efforts have not been consistently effective. Policies, such as paid parental leave could potentially prevent AHT, given its impacts on risk factors for child maltreatment. To explore associations between California's 2004 paid family leave (PFL) policy and hospital admissions for AHT, we used difference-in-difference analyses of 1995–2011 US state-level data before and after the policy in California and seven comparison states. Compared to seven states with no PFL policies, California's 2004 PFL showed a significant decrease of AHT admissions in both < 1 and < 2year-olds. Analyses using additional data years and comparators could yield different results.

### Keywords

child abuse; shaken baby syndrome

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In the United States, pediatric abusive head trauma (AHT) is a leading cause of fatal child maltreatment among young children.[1] Survivors can suffer severe, long-term neurological and physical impairment.[2] The majority of victims are less than 2 years old, with peak incidence between 9–20 weeks.[2] This peak coincides with developmentally typical episodes of prolonged and inconsolable infant crying.[2]AHT prevention has primarily focused on providing parents of newborns with information about infant crying and the dangers of violent infant shaking.[2] Although such programs initially yielded promising results,[3] subsequent rigorous evaluation efforts failed to show reductions in serious AHT incidence.[4]

Societal-level interventions, such as public policies, reach broader segments of the population and may have a longer, sustained impact on reducing child maltreatment.[5] In particular, paid family leave (PFL) policies that allow new mothers to delay re-entry into the workforce may hold promise for AHT prevention. New mothers can care for their infants

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Address correspondence to: Joanne Klevens, 4770 Buford Hwy, Mailstop F-63, Atlanta, GA 30341; jklevens@cdc.gov; Telephone 770-488-1386.

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instead of or alongside male caregivers (most perpetrators of AHT are males). Research based on individual-level data suggests PFL is associated, perhaps not causatively, with positive parental and child health outcomes, including reduced maternal depression[6] and preschoolers' externalizing behaviors.[7] PFL can also reduce family stress by improving family income during the time leave is taken and beyond.[8] A possible mechanism to explain effects beyond the period of PFL is maternal stress and depression's effects on a child's hypothalamic-pituitary-adrenal system which alters the child's response to stress and affects other systems, including emotional regulation.[9]

In 2002, California enacted PFL (Senate Bill 1661), Family Temporary Disability Insurance, to provide wage replacement benefits to workers who take time off work to care for a seriously ill relative or to bond with a new child; this bill began paying benefits to eligible parents on July 1, 2004.[10] The state's law provides up to six weeks of partially paid leave (up to 55% of employees' wages) for employees qualifying for State Disability Insurance (SDI). Average benefits paid under the law ranged from \$405 a week in 2004 to \$526 in 2013.[10] When taken consecutively with benefits provided by California's SDI, employees have up to 12 weeks of partially paid leave after the birth of a baby. Based on previous evidence that PFL can reduce parental stress and depression and children's externalizing behaviors (known risk factors for child maltreatment[11]), we explored the associations between California's PFL policy and AHT hospital admissions. Previous analyses using an interrupted time series design (not reported) led to inconclusive results most likely due to lack of power. It also lacked controls for potential confounders. Our current analyses use a difference-in-difference design.

## METHODS

We constructed a panel data set which included the annual data of California and 7 comparison states. We used difference-in-difference analyses of publicly-available, state-level data from 1995–2011 to compare the population rate of AHT hospital admissions in California versus other US states that had no PFL policy change before and after the policy change.

### Data

We identified inpatient admissions with AHT diagnoses (referred to as AHT admissions) in the 1995–2011 Statewide Inpatient Databases (SID) from the Healthcare Cost and Utilization Project.[12] SID is the largest publicly-available, state-based, all-payer (i.e., patients with public insurance, private insurance, and no insurance), inpatient care database in the US, reporting all inpatient discharges annually in participating states.[12] Admissions were included in this analysis if a combination of International Classification of Diseases, Ninth Revision, Clinical Modification and External Cause of Injury diagnosis codes indicated definite or probable AHT based on the CDC definitions.[13] We calculated the annual age-specific population rate of AHT admissions among children by age per 100,000 population.[14] Data on 2002 California AHT admissions was unavailable so we interpolated the state's rate that year from surrounding years' data using *Proc Expand* in SAS 9.3 (SAS Institute, Cary, NC).

Our main analysis investigated AHT admissions among children < 1 year old, which includes the peak AHT incidence and partially coincides with parents' paid time off under California's PFL law. Given PFL's associations with effects beyond the period of paid leave, we also investigated a longer-term impact from parents' paid time off by including AHT admissions among children up to two years of age.

### Comparison states

Each US state determines whether to release its data through SID and not all states choose to do so. States selected for comparisons to California were based on a combination of available SID data for all study years and the generosity of states' parental leave policies. This resulted in a group of seven states (all those with complete data and a parental leave generosity rating of C or less, on a "grading" scale of A- to F from the National Partnership for Women and Families;<sup>[15]</sup> Arizona, Colorado, Florida, Iowa, Maryland, Massachusetts, and Wisconsin). New Jersey, New York, Oregon, and Washington had complete data but were excluded because these states had B ratings; and South Carolina was excluded because their data had differing age groups across the study years. Table 1 summarizes parental leave policies in the seven selected states.

### Statistical Analysis

In these regression models, the dependent variable was AHT admission rate per 100,000 population in California and in the comparator states from 1995–2011. The policy variable takes the value of 0 from 1995 to 2004 and the value of 1 from 2005 (for <1 year-old model) and from 2006 (for < 2 year-old model) to 2011 for California and the value of 0 from 1995 to 2011 for the 7 comparison states. In the unadjusted model, we included only the PFL policy variable plus the state and year dummy variables which captured time-invariant state characteristics and time effects common to all 8 states, respectively. In the adjusted model, we included two additional variables (unemployment rate and percentage of adults with education less than high school), to control for economic and parental factors and their potential impacts on AHT admissions. For both unadjusted and adjusted models, we used the robust standard errors which were robust to potential misspecification such as heteroscedasticity or within-panel serial correlation in the error term. A p-value of <.05 was considered statistically significant.

## RESULTS

Figure 1 demonstrates AHT admission rates for children < 1 year of age (dark gray) and < 2 years of age (light gray) per 100,000 population in California (squares) and the comparison (triangles) states' group average from 1995–2011. This figure shows increases in AHT admission rates starting in 2007 thru 2009 in comparator states while California's rates remained relatively stable.

Table 2 reports the regression results. Our difference-in-difference analysis shows that the implementation of the PFL policy was significantly associated with a level decrease of 5.8 in the AHT admissions per 100,000 children < 1 year, when the unemployment rate and the percentage of adults with education less than high school were not controlled (unadjusted

estimate). After controlling for the unemployment rate and the percentage of adults with education less than high school (adjusted estimate), our analysis still shows a significant decline; specifically, implementation of the PFL policy was associated with a decrease of 5.1 in the AHT admissions per 100,000 children < 1 year. The changes in the AHT admissions per 100,000 < 2 years are similar. The implementation of the PFL policy was significantly associated with a level decrease of 2.8 or 3.2 in the AHT admissions per 100,000 < 2 years, depending on whether the unemployment rate and the percentage of adults with education less than high school were controlled for or not.

## DISCUSSION

Given the small evidence base for policies to reduce child maltreatment and PFL's impact on risk factors for child abuse, we explored the impact of California's PFL policy on AHT hospitalization rates. Our difference-in-difference analyses shows that the implementation of the PFL policy was significantly associated with a decrease in AHT admissions in both children < 1 and < 2 years of age. Specifically, while the comparison states experienced increases in AHT rates during the years known as the Great Recession (an increase others have also observed[16]), California did not.

Although significant, this difference occurred despite low uptake of the policy's benefits. Participation in California's PFL policy started at 25% in the first year of implementation but remains low—just 38% of eligible parents in 2014.[10] In addition, those at higher risk for perpetrating AHT (i.e., non-Whites, high school education or less[17]) were less likely to (or perhaps, could not afford to given only partial reimbursement) take leave under the policy.[8] Furthermore, over half of parents at highest risk of AHT (younger, non-Whites, those with less education or household income) were unaware of this law in California.[8] This differential access to PFL, which results in more advantaged groups gaining access to the benefits, could contribute to increasing the inequitable burden of AHT. Moreover, when parents did take advantage of California's PFL and SDI, they only took, on average, six weeks of leave[18]—not enough to cover the period of increased infant crying associated with AHT. The impact of California's PFL policy on AHT may or not be greater if more parents at high risk were aware of the law, could afford to take advantage of it, and used the full 12 weeks allowable. Extending PFL to cover the full period of increased infant crying and peak AHT incidence (i.e., 20 weeks[2]) may or not improve its impact. These are both important questions for future research to explore.

Although the use of the commonly used econometric difference-in-difference analysis to better estimate the effects compared with nonintervention control states is an important methodological strength, our analysis was limited to AHT inpatient admissions, and did not examine, for example, AHT diagnosed in other clinical settings or AHT mortality. In addition, administrative coding in hospital records likely underestimates true AHT prevalence although the ICD codes we used have shown a sensitivity of 92% and specificity of 96% for hospital admissions[19]. The state comparisons to California were limited by data availability in SID. Analysis of this issue at the individual or family level, capturing parents' PFL participation, would facilitate more robust conclusions about the impact of

California's policy on children's health, including AHT. Analyses of this topic using additional data years and comparators could yield different results.

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## Abbreviations

<b>AHT</b>	Abusive head trauma
<b>CDC</b>	Centers for Disease Control and Prevention

## REFERENCES

1. Klebens J, Leeb R. Child maltreatment fatalities in children under five: Findings from the National Violent Death Reporting System. *Child Abuse Negl.* 2010; 34:262–266. [PubMed: 20304491]
2. Barr RG. Preventing abusive head trauma resulting from a failure of normal interaction between infants and their caregivers. *PNAS.* 2012; 109:17294–17301. [PubMed: 23045677]
3. Dias MS, Smith K, deGuehery K, et al. Preventing abusive head trauma among infants and young children: A hospital-based, parent education program. *Pediatrics.* 2005; 115:e470–e477. [PubMed: 15805350]
4. Zolotor AJ, Runyan DK, Shanahan M, et al. A statewide abusive head trauma prevention program. *JAMA Ped.* 2015 Published online October 26.
5. Klebens J, Barnett SB, Florence C, et al. Exploring policies for the reduction of child physical abuse and neglect. *Child Abuse Negl.* 2015; 40:1–11. (2014). [PubMed: 25124051]
6. Chatterji P, Markowitz S. Family leave after childbirth and the mental health of new mothers. *J Ment Health Policy and Econ.* 2012; 15:61–76. [PubMed: 22813939]
7. Berger LM, Hill J, Waldfogel J. Maternity leave, early maternal employment and child health and development in the US. *Econ J.* 2005; 115:F29–F47.
8. Rosin-Slater M, Ruhm CJ, Waldfogel J. The effects of California's Paid Family Leave Program on mothers' leave-taking and subsequent labor market outcomes. *J Policy Anal Manage.* 2013; 32:224–245. [PubMed: 23547324]
9. Essex MJ, Klein MH, Cho E, et al. Maternal stress beginning in infancy may sensitize children to later stress exposure: Effects on cortisol and behavior. *Biol Psychiatry.* 2002; 52:776–784. [PubMed: 12372649]
10. State of California. Paid Family Leave: Ten years of assisting Californians in need. State of California, Labor and Workforce Development Agency, Employment Development Department; 2014. [http://edd.ca.gov/Disability/pdf/Paid\\_Family\\_Leave\\_10\\_Year\\_Anniversary\\_Report.pdf](http://edd.ca.gov/Disability/pdf/Paid_Family_Leave_10_Year_Anniversary_Report.pdf) [accessed 3 Feb 2015]
11. Stith SM, Lui T, Davies C, et al. Risk factors in child maltreatment. A meta-analytic review of the literature. *Aggress Violent Behav.* 2009; 14:13–29.
12. [accessed 6 Feb 2015] Healthcare Cost and Utilization Project. Overview of the Statewide Inpatient Databases. 2014. <http://www.hcup-us.ahrq.gov/sidoverview.jsp>
13. Parks, S.; Annet, J.; Hill, H., et al. Pediatric Abusive Head Trauma: Recommended Definitions for Public Health Surveillance and Research. Atlanta, GA: Centers for Disease Control and Prevention; 2012.
14. Centers for Disease Control and Prevention (CDC). Bridged-race population estimates: data files and documentation. Hyattsville, MD: CDC, National Center for Health Statistics; 2014. [http://www.cdc.gov/nchs/nvss/bridged\\_race.htm](http://www.cdc.gov/nchs/nvss/bridged_race.htm) [accessed 11 Feb 2015]

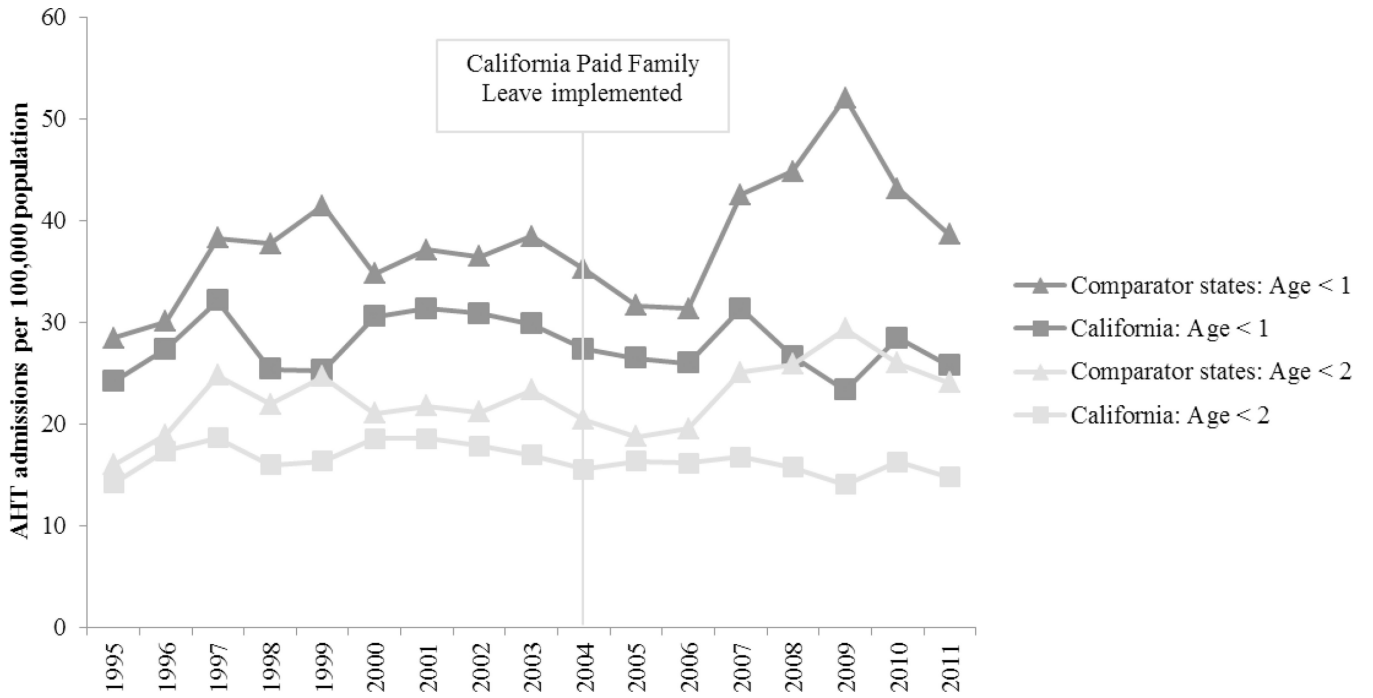
15. National Partnership for Women and Families. Expecting Better: A State-by-State Analysis of Laws That Help New Parents. Washington, DC: Author; 2012. <http://www.nationalpartnership.org/research-library/work-family/expecting-better.pdf> [accessed 26 May 2015]
16. Wood JN, French B, Fromkin J, et al. Association of pediatric abusive head trauma rates with macroeconomic indicators. *Acad Pediatr*. 2015 DOI: <http://dx.doi.org/10.1016/j.acap.2015.05.008>.
17. Kessler H, Dias MS, Shaffer M, et al. Demographics of abusive head trauma in the commonwealth of Pennsylvania. *J Neurosurg Pediatr*. 2008; 1:351–356. [PubMed: 18447667]
18. Appelbaum, E.; Milkman, R. Leaves that pay: Employer and worker experiences with paid family leave in California. Washington, D.C.: Center for Economic and Policy Research; 2011. [www.cepr.net/documents/publications/paid-family-leave-1-2011.pdf](http://www.cepr.net/documents/publications/paid-family-leave-1-2011.pdf) [accessed 26 May 2015]
19. Berger RP, Parks S, Fromkin J, et al. Assessing the accuracy of the International Classification of Diseases codes to identify abusive head trauma: a feasibility study. *Inj Prev*. published online October 28, 2013.

**KEY MESSAGES****What is already known?**

- AHT is a leading cause of fatal child maltreatment among young children and serious long-term impairments for surviving children
- Preventive efforts have not been consistently effective
- Paid family leave (PFL) has positive impacts on risk and protective factors for child maltreatment

**What this study adds**

- Promising evidence of impact of PFL on AHT hospital admissions



**Figure 1. Abusive Head Trauma Admission Rates per 100,000 for children age <1 and <2 year in California and comparator states, 1995–2011**

*Notes.* AHT: abusive head trauma. Comparator states measure is the average rate by year for seven states: Arizona, Colorado, Florida, Iowa, Maryland, Massachusetts, and Wisconsin. Data from individual states available upon request.



Expansions beyond federal family and medical leave law of family leave laws in California and seven comparison states for the private sector and government sector

**Table 1**

Expansions	COMPARISON STATES															
	CA	AZ	CO	FL	IA	MD	MA	WI	Gov	Priv	Gov	Priv	Gov	Priv	Gov	
Partial wage replacement																
Increased time for medical reasons																
Can use sick leave to care for child																
Job tenure requirements waived																
Hours worked requirement waived																
Job protected while on leave																
Includes domestic partners																
Nursing moms get break and privacy																

<sup>a</sup> Only if bargaining unit opted in

**Table 2**

Difference-in-Difference Analyses of the Effect of the Paid Family Leave Policy on Abusive Head Trauma Admissions

Dependent variable: AHT admissions per 100,000 < 1 year		
Variable	Unadjusted Estimate (s.e.); <i>P</i> -value	Adjusted Estimate (s.e.); <i>P</i> -value
Paid Family Leave Policy	<b>-5.820 (2.296); <i>P</i> = 0.039</b>	<b>-5.113 (1.964); <i>P</i> = 0.035</b>
Unemployment Rate		0.783 (1.175); <i>P</i> = 0.526
Adult Education < High School		-0.834 (0.476); <i>P</i> = 0.123
Dependent variable: AHT admissions per 100,000 < 2 years		
Variable	Unadjusted Estimate (s.e.); <i>P</i> -value	Adjusted Estimate (s.e.); <i>P</i> -value
Paid Family Leave Policy	<b>-3.246 (1.265); <i>P</i> = 0.037</b>	<b>-2.799 (1.085); <i>P</i> = 0.036</b>
Unemployment Rate		0.313 (0.602); <i>P</i> = 0.619
Adult Education High School		-0.476 (0.229); <i>P</i> = 0.076

*Notes.* AHT: abusive head trauma; s.e.: standard error. All models included state and year dummy variables and reported robust standard errors.