

## Nonfatal Abusive Head Trauma (AHT) Hospitalizations among Children <5 Years of Age, California, 2005-2014

### What is Abusive Head Trauma (AHT)?

AHT (often incorrectly referred to as Shaken Baby Syndrome) is defined as an injury to the skull or intracranial contents of an infant or a young child (<5 years of age) due to inflicted blunt impact and/or violent shaking.<sup>1</sup> In the United States, abuse is the third leading cause of head injuries among children, after falls and motor vehicle crashes. Children under 2 years of age experience the greatest incidence of serious AHT, at 18.7 per 100,000 child population.<sup>2</sup> Survivors of AHT can suffer severe, long-term, neurological, and physical impairments. Common adverse outcomes may include numerous cognitive and neurological sequelae including motor and visual deficits, epilepsy, and speech, language and behavioral problems.<sup>2</sup>

### What is the purpose of this fact sheet?

Currently, there is very little information available on AHT in California.<sup>3</sup> This fact sheet describes 10-year trends in nonfatal AHT hospitalization rates for children <5 years of age in California overall and for each county from 2005-2014. Data used for this analysis are from the statewide in-hospital patient discharge files maintained by the Office of Statewide Health Planning and Development.<sup>4</sup> AHT cases were included in the analysis if they met the Centers for Disease Control and Prevention's (CDC) non-fatal AHT case definitions.<sup>2</sup> Children with AHT who died in the hospital were excluded. These case definitions do not depend on an explicit diagnosis of AHT, but rather use a combination of ICD-9 CM diagnostic codes and external cause-of-injury codes. Because of the likely under ascertainment of AHT (e.g., lack of witnesses; potential reluctance of a physician to diagnosis AHT), using diagnostic codes is a more objective method for capturing AHT from the hospital records.

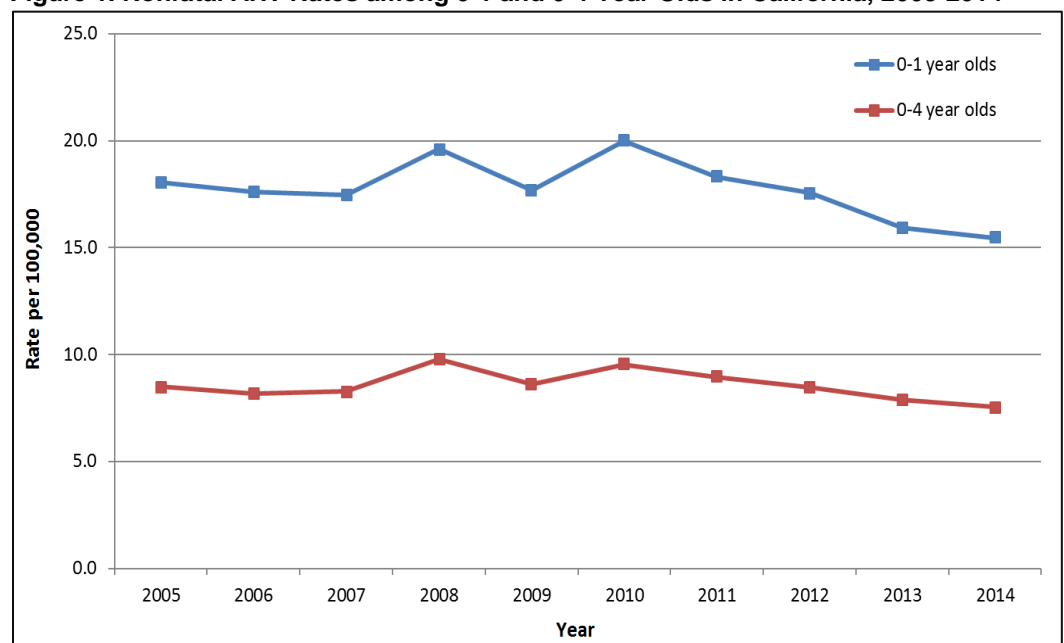
### California Trends

Figure 1 displays the nonfatal AHT hospitalization rates from 2005 to 2014 for 0-1 and 0-4 year olds in California. There were a total of 2,182 nonfatal AHT hospital discharges among <5 year olds over the 10-year period for an overall rate of 8.6 per 100,000 California resident children <5 years of age.

Approximately 80% of these AHT cases occur among children under 2 years of age (17.8 per 100,000). The rates for nonfatal AHT peaked in 2008 and 2010 for both age groups. In addition, both age

groups experienced a decline in nonfatal AHT rates from 2010-2014. The decline in nonfatal AHT rates from 2010-2014 was significant among 0-1 year olds with an annual percent decrease of 5.6% ( $p < 0.001$ ). The 0-4 age group had a similar 5.5% annual decrease, however, the decline did not reach statistical significance ( $p = 0.10$ ).

**Figure 1. Nonfatal AHT Rates among 0-1 and 0-4 Year Olds in California, 2005-2014**



## Nonfatal AHT Child Demographics

Table 1 presents child demographics of children with nonfatal AHT hospitalizations in California from 2005-2014. Those <1 year of age had a significantly higher rate (28.6 per 100,000) compared to all other age groups <5 years. Males had a significantly higher rate (9.9 per 100,000) than females. Latino/Hispanic children accounted for the majority of nonfatal AHT cases (51%) but the AHT rates for Latinos were lower than all other race/ethnicity categories except Asians. African American children had a significantly higher rate (19.0 per 100,000) compared to the other ethnicities. Because race/ethnicity categories are socially constructed these findings may mask the complex relationship among these categories and the broader social economic conditions in which people live in California, which include disparities in poverty and socioeconomic status. For example, those on Medi-Cal accounted for 70% of nonfatal AHT cases compared to those on private, other government insurance, and the uninsured.

**Table 1. Child Demographics (<5 years) of Nonfatal AHT Hospitalizations, 2005-2014, California (N=2182)**

Characteristics	%	Rate (95% CI) <sup>€</sup>
<u>Age (in years)</u>		
0	66.9	28.6 (27.1, 30.1)
1	16.0	6.9 (6.2, 7.6)
2	9.5	4.1 (3.5, 4.6)
3	4.5	1.9 (1.5, 2.3)
4	3.1	1.3 (1.0, 1.7)
<u>Sex</u>		
Males	58.9	9.9 (9.3, 10.4)
Females	41.2	7.2 (6.7, 7.7)
<u>Race/ethnicity</u>		
African American	12.5	19.0 (16.7, 21.4)
Asian	3.2	2.4 (1.9, 3.1)
Latino/Hispanic	50.9	7.8 (7.3, 8.2)
White	33.4	12.2 (11.4, 13.0)
<u>Pay Source</u>		
Medi-Cal	70.3	N/A
Private	14.6	
Other Government	13.2	
Uninsured	1.9	

<sup>€</sup>Rate per 100,000 with 95% Confidence Intervals

**Table 2. County Rates for Nonfatal AHT Hospitalizations among 0-4 Year Olds in California, 2005-2014\*\***

Rank	County	Total # of AHT	Rate (95% CI) <sup>€</sup>	5-year % Change <sup>¥</sup>
1	San Bernardino	337	21.4 (19.1, 23.7)*	19.9
2	Riverside	284	17.9 (15.8, 19.9)*	21.8
3	Fresno	122	15.6 (12.9, 18.4)*	- 17.2
4	Butte	19	15.6 (9.4, 23.9)*	- 9.5
5	Shasta	16	15.5 (8.9, 24.6)	29.3
6	Kern	82	11.6 (9.2, 14.3)*	2.7
7	Imperial	16	11.5 (6.6, 18.2)	- 25.7
8	San Diego	224	10.8 (9.4, 12.2)*	14.5
9	Sacramento	104	10.4 (8.4, 12.4)	- 19.1
10	Merced	22	10.0 (6.3, 14.9)	82.1
11	Tulare	38	9.4 (6.7, 12.8)	- 27.3
12	Stanislaus	36	9.0 (6.3, 12.4)	- 59.8
13	Solano	24	9.0 (5.7, 13.1)	- 11.0
	<b>CALIFORNIA</b>	<b>2182</b>	<b>8.6 (8.2, 9.0)</b>	<b>- 2.2</b>
14	San Joaquin	45	8.3 (6.1, 11.1)	- 22.6
15	Alameda	63	6.5 (5.0, 8.2)	- 23.8
16	Monterey	20	6.1 (3.7, 9.3)	24.6
17	Los Angeles	391	5.9 (5.3, 6.5)*	0.3
18	Sonoma	16	5.7 (3.3, 9.1)	5.3
19	San Francisco	19	5.2 (3.1, 8.0)*	- 69.8
20	Contra Costa	28	4.2 (2.8, 6.0)*	- 76.5 <sup>^</sup>
21	Orange	74	3.8 (3.0, 4.7)*	- 30.7
22	Santa Clara	46	3.7 (2.7, 4.9)*	- 12.8
23	Ventura	18	3.2 (1.9, 5.0)*	- 47.0

\*\*Only counties with 15 or more non-fatal AHT cases during the 10-year period are included.

<sup>€</sup>Rate per 100,000 with 95% confidence intervals during 10-year period (2005-2014)

<sup>¥</sup>2005-2009 vs. 2010-2014

\*County rates are significantly different from California at p=0.05.

<sup>^</sup>Rates between the two 5-year periods significantly decreased at p=0.05.

## County Trends

Rates for each county with 15 or more nonfatal AHT cases among 0-4 year olds during 2005-2014 are presented in Table 2. Data for all children under 5 are used to provide a larger sample and increase the stability of the rates for each county. County rates for 0-1 year olds are not shown but have very similar patterns. 95% confidence intervals for the overall 10-year rates for each county were calculated (shown in the fourth column of Table 2) to determine which, if any, of the counties were significantly higher or lower than the state rate. The following six counties had significantly higher nonfatal AHT rates (p<0.05) than the state average of 8.6 per 100,000 during the 10-year period: San Bernardino (21.4 per 100,000), Riverside (17.9 per 100,000), Fresno (15.6 per 100,000), Butte (15.6 per 100,000), Kern (11.6 per 100,000), and San Diego (10.8 per 100,000). In addition, six counties had significantly lower rates (p<0.05) than the state average during the 10-year period: Los Angeles (5.9 per 100,000), San Francisco (5.2 per 100,000), Contra Costa (4.2 per 100,000), Orange (3.8 per 100,000), Santa Clara (3.7 per 100,000) and Ventura (3.2 per 100,000).

The rates and 95% confidence intervals for both 5-year periods (2004-2009 and 2010-2014) were also calculated for each county but are not shown. However, the percent change in nonfatal AHT rates between the two 5-year periods (2005-2009 and 2010-2014) for each county is indicated in the fifth column of Table 2. There were a total of nine counties that experienced an increase in the percent change of nonfatal AHT rates between the two 5-year periods. Merced and Shasta Counties had the largest percent increases of 82% and 29% respectively, but because of the relatively small numbers, the increases were not statistically significant. In addition, there were a total of fifteen counties that experienced

a decrease in the percent change of nonfatal AHT rates between the two 5-year periods (all of which were nonsignificant decreases except for Contra Costa County). Contra Costa County had the largest significant percent decline at 76.5% ( $p<0.05$ ), followed by San Francisco at 69.8%.

### *Limitations*

There are several limitations to using hospital discharge data to identify nonfatal AHT cases. First, there is wide variation in the degree to which physicians and hospital staff are able to identify and document AHT. AHT can be mistaken for common disease conditions or accidental injury. Without special training and diagnostic methods it may be difficult to confirm AHT. Therefore, AHT cases are likely underreported. However, use of the CDC standard nonfatal AHT case definition based on the ICD-9 CM diagnostic and external cause-of-injury codes has been shown to be a valid method of case ascertainment.<sup>5</sup> Lastly, AHT children who died in the hospital ( $n=158$ ) were excluded because only a portion of fatal AHT cases are admitted to the hospital prior to death, thus the hospital portion provides an incomplete and potentially misleading count of AHT fatalities.



### *Discussion*

All forms of child maltreatment, including AHT, are preventable. Programmatic efforts to prevent AHT have tended to focus on providing parents and other caregivers with information about the danger of shaking babies, child development, and how to deal with infant crying. Several studies have shown these types of programs have been successful in increasing parental knowledge and changing attitudes about infant crying. As a result, many states have passed laws mandating AHT prevention education in hospitals and other settings.<sup>6</sup>

“Don’t Shake the Baby” is an educational campaign that informs new parents about the dangers of shaking a baby. Showers (1992) examined the effectiveness of this campaign in influencing parental knowledge. Findings revealed that only 49% of new mothers reported they would be less likely to shake their babies after reading the information in the packet. In addition, the study did not follow up with the mothers to determine whether the informational packets led to an actual decline in abusive head trauma rates.<sup>7</sup> This suggests that preventive strategies may need to include more than simple awareness-raising interventions.

The Period of PURPLE Crying<sup>8</sup> is a parent education program that teaches parents about normal infant crying, how to cope, and the dangers of reacting to frustration with infant crying. There are numerous studies that have shown PURPLE Crying to be an effective educational strategy.<sup>9 10</sup> However, a recent statewide study conducted in North Carolina on PURPLE Crying revealed that although parental knowledge on infant crying had increased, state-level AHT rates remained unchanged.<sup>11</sup>

The DIAS model<sup>12</sup> intervention is a comprehensive hospital-based program focused on parent education at the time of childbirth. The intervention was implemented in Upstate New York during 1998-2003 and revealed a 47% decrease in AHT incidence at the end of the 5-year period. The DIAS model has been implemented as a statewide replication in several other states, however they have not been able to replicate the promising results seen in New York. Pennsylvania, for example, experienced an increase in AHT incidence.<sup>13</sup>

These interventions were successful in raising awareness, but were not able to demonstrate consistent reductions in the incidence of AHT. In order to create more effective interventions, we may need to expand beyond the conventional “focus on the parents” narrative and take into account the larger social ecology. For example, adopting family friendly work place policies may be protective by allowing new mothers to delay re-entry into the workforce and providing them with more time to care for their infants. One recent study has shown promising results that societal-level interventions such as implementing paid-family leave policies may have a prolonged, sustained impact on reducing child maltreatment and AHT incidence.



The study conducted by Klevens et.al (2016) examined the association between the adoption of California's 2004 Paid Family Leave (PFL) Policy and hospital admissions for AHT over time. Findings revealed implementation of the PFL policy was significantly associated with lower incidences of AHT admissions in children <1 and <2 years of age over time and compared to other states without such policies.<sup>14</sup>

### Conclusion

Although the decline in AHT incidence from 2010-2014 in California is encouraging, AHT is still a substantial child protection and public health problem. In addition, several counties actually experienced an increase in AHT incidence among children <5. Therefore, additional efforts are needed to prevent AHT. Prevention efforts should not solely focus on parental behavior, but also include societal-level strategies. This broader societal approach includes community partners, business, education, and health sectors in a dialogue about society's shared role in promoting child well-being. It may open the door to new initiatives and system changes that can strengthen families and provide all children with safe, stable, nurturing relationships, and environments.

<sup>1</sup> Centers for Disease Control and Prevention. (2012). [Pediatric abusive head trauma: Recommended Definitions for Public Health and Research](#).

<sup>2</sup> Parks, S., Sugerman, D., Likang, X., Victor, C. (2012). Characteristics of non-fatal abusive head trauma among children in the USA, 2003-2008: application of the CDC operational case definition to national hospital inpatient data. *Injury Prevention*, 18(3), 193-199. doi: 10.1136/injuryprev-2011-040128

<sup>3</sup> Wirtz, S.J., Trent, R.B. (2008). Passive surveillance of shaken baby syndrome using hospital inpatient data. *American Journal of Preventative Medicine*, 34(4), 134-139. doi: 10.1016/j.amepre.2007.11.004

<sup>4</sup> Office of Statewide Health Planning and Development, <http://www.oshpd.ca.gov/>

<sup>5</sup> Berger, R.P., Parks, S., Fromet, J., Rubin, P., and Pecora, P.J. (2015) Assessing the accuracy of the International Classification of Diseases codes to identify abusive head trauma: A feasibility study. *Injury Prevention* 21(0), 133-137. doi: 10.1136/injuryprev-2013-040924

<sup>6</sup> National Conference of State Legislatures. (2014). [Shaken Baby Syndrome Prevention Legislation](#).

<sup>7</sup> Showers, J. (1992). "Don't shake the baby": The effectiveness of a prevention program. *Child Abuse & Neglect*, 16(1), 11-18. doi: 10.1016/0145-2134(92)90004-B

<sup>8</sup> [The Period of Purple Crying](#). The National Center on Shaken Baby Syndrome.

<sup>9</sup> Barr, R. G., Rivara, F. P., Barr, M., Cummings, P., Taylor, J., Lengua, L. J., & Meredith-Benitz, E. (2009). Effectiveness of Educational Materials Designed to Change Knowledge and Behaviors Regarding Crying and Shaken-Baby Syndrome in Mothers of Newborns: A Randomized, Controlled Trial. *Pediatrics*, 123(3), 972-980. doi: 10.1542/peds.2008-0908

<sup>10</sup> Barr, R. G., Rajabali, F., Aragon, M., Colbourne, M., & Brant, R. (2015). Education About Crying in Normal Infants Is Associated with a Reduction in Pediatric Emergency Room Visits for Crying Complaints. *Journal of Developmental & Behavioral Pediatrics*, 36(4), 252-257. doi: 10.1097/DBP.0000000000000156

<sup>11</sup> Zolotor, A.J., Runyan, D.K., Shanahan, M., Durrance, C.P., Nocera, M., Sullivan, K., Klevens, J., Murphy, R., Barr, M., Barr, R.G. (2015). Effectiveness of a Statewide Abusive Head Trauma Prevention Program in North Carolina. *JAMA Pediatrics*, 169(12), 1126-1131. doi:10.1001/jamapediatrics.2015.2690

<sup>12</sup> Dias, M.S., Smith, K., DeGuehery, K., Mazur, P., Li, V., Shaffer, M.L. (2005). Preventing abusive head trauma among infants and young children: a hospital-based, parent education program. *Pediatrics*, 115(4), 470-477. doi: 10.1542/peds.2004-1896

<sup>13</sup> Pennsylvania Shaken Baby Syndrome Prevention Program, personal communication, September 17, 2016

<sup>14</sup> Klevens, J., Feijun, L., Likang, X., Cora, P., Latzman, N. (2016). Paid family leave's effect on hospital admissions for pediatric abusive head trauma. *Injury Prevention*, 1-4. doi: 10.1136/injuryprev-2015-041702

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