



Full length article

Are community level prescription opioid overdoses associated with child harm? A spatial analysis of California zip codes, 2001–2011

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ABSTRACT

Background: Non-medical prescription opioid use is increasing globally within high-income countries, particularly the United States. However, little is known about whether it is associated with negative outcomes for children. In this study, we use prescription opioid overdose as a proxy measure for non-medical prescription opioid use and ask the following: Do California communities with greater rates of non-medical prescription opioid use also have higher rates of child maltreatment and unintentional child injury?

Methods: We used longitudinal population data to examine ecological associations between hospital discharges involving overdose of prescription opioids and those for child maltreatment or child injury in California zip codes between 2001 and 2011 ($n = 18,517$ zip-code year units) using Bayesian space-time misalignment models.

Results: The percentage of hospital discharges involving prescription opioid overdose was positively associated with the number of hospital discharges for child maltreatment (relative rate = 1.089, 95% credible interval (1.004, 1.165)) and child injury (relative rate = 1.055, 95% credible interval (1.012, 1.096)) over the ten-year period, controlling for other substance use and environmental factors.

Conclusions: Increases in community level prescription opioid overdoses between 2001 and 2011 are associated with a 2.06% increase in child maltreatment discharges and a 1.27% increase in discharges for child injury. Communities with higher rates of non-medical prescription opioid use may experience greater levels of child harms.

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1. Introduction

Parenting behaviors can contribute to both intentional and unintentional harms to children and are important targets for prevention. Child maltreatment, which includes both abusive and neglectful parenting behaviors, remains a substantial problem within high-income countries with yearly estimates of 4–16% of children being physically abused and 10% being neglected or psychologically abused (Gilbert et al., 2009). In the United States, approximately 686,000 children are identified as victims of maltreatment each year (U.S. Department of Health and Human Services, 2013) and as many as 12.5 percent of children are estimated to experience maltreatment before age 18 (Wildeman et al., 2014). In addition to the immediate harms that result from child

maltreatment, these children are at risk for life-long emotional, social, and physical health problems such as depression, anxiety, low social support, suicide, serotonergic dysfunction and cardiovascular disease (Berglund et al., 2013; Fuller-Thomson et al., 2011; Marshall et al., 2013; McCauley et al., 1997; Norman et al., 2012; Sperry and Widom, 2013; Springer et al., 2007). As a result of these consequences, just one year of confirmed cases of maltreatment in the United States results in approximately \$124 billion dollars of costs to society (Fang et al., 2012).

In addition, many children experience concerning levels of harm through unintentional injuries, which are consistently identified as some of the top 15 causes of death worldwide and within the top 10 causes of death within high income countries (World Health Organization, 2008). It is the number one cause of child mortality in the United States (Center for Disease Control and Prevention, 2012). Children experiencing unintentional injury may be victims of neglectful parenting not captured by current surveillance systems. Many unintentional injuries (excluding motor vehicle accidents) have been associated with insufficient supervision (Ewigman et al.,

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1993) including some poisonings (Ozanne-Smith et al., 2001), pedestrian injuries (Winn et al., 1991), burns (Cerovac and Roberts, 2000), and injury fatalities (Landen et al., 2003). In fact, children who have been reported to child welfare services for neglect within the United States have higher risk of death due to unintentional injury (Putnam-Hornstein et al., 2013).

Ecological studies conducted within the United States have found that characteristics of the substance use environment, which includes the availability of substances through formal or informal means as well as the geographic concentration of users, are associated with negative outcomes for children. Both on-premise (e.g., bars or restaurants) and off-premise (e.g., liquor stores) alcohol outlets are associated with neighborhood child maltreatment rates (Freisthler et al., 2012; Freisthler and Weiss, 2008; Morton, 2013; Morton et al., 2014), although some of the literature is mixed (Morton et al., 2014). Neighborhood indicators of drug markets, such as drug sales (Freisthler et al., 2012), and drug arrests (Albert and Barth, 1996; Freisthler et al., 2005; Freisthler and Weiss, 2008), have also been associated with referrals to child protective services or maltreatment rates. The mechanisms by which the substance use environment is related to child maltreatment remain primarily unknown. In the case of alcohol, people who live in neighborhoods with greater access to alcohol drink more frequently and in greater quantities (Gruenewald et al., 2014). Thus parents who live in neighborhoods with greater access to substances may use them more and the physiological effects of the substances could result in maltreatment. Recent multi-level research, however, suggests that the substance use environment impacts parenting outside of individual behaviors (Freisthler and Gruenewald, 2013; Freisthler et al., 2014), indicating other unknown social and ecological mechanisms. Neighborhoods with more substance use and access to substances may have lower levels of social control (e.g., people willing to intervene in problematic situations such as maltreatment).

In comparison to other substances, little is known about whether the prescription opioid environment (i.e., availability of prescription opioids and concentration of users) is independently related to child harms, despite the recent and large increase in prescription opioid use world-wide. Since the 1990s, medical use of prescription opioids has tripled with the predominant increase occurring in high income counties (International Narcotics Control Board, 2012). There is some evidence of emerging trends for medical and non-medical prescription opioid use within the European Union; however, the highest rates of increase have been observed within the United States (European Monitoring Centre for Drugs and Drug Addiction, 2011; International Narcotics Control Board, 2012; Shei et al., 2015). Between 1996 and 2011 in the United States, medical use of prescription opioids rose 1448% while non-medical use (i.e., use without a prescription or in ways other than which it was prescribed) rose 4680% (Alturi et al., 2014). In addition, United States mortality from prescription opioid overdose increased 200% from 2000 to 2014 (Rudd et al., 2016). In 2007, non-medical prescription opioid use cost U.S. society an estimated \$55.7 billion due to lost earnings from premature death or unemployment, health care costs, and criminal incarceration (Birnbaum et al., 2011). In California, there are 596.3 opioid prescriptions per 1000 residents as of 2013 (Paulozzi et al., 2015).

Emerging research in the United States suggests that non-medical prescription opioid use has a spatial dimension, with rates of abuse or overdose varying between neighborhoods (Brownstein et al., 2010), rural or urban areas (Green et al., 2011; Monnat and Rigg, 2016), and cities (Golub et al., 2013). Compared to other illicit drugs like heroin, prescription opioid overdoses may be more likely to occur in neighborhoods with higher incomes and less family fragmentation (Cerdeira et al., 2013). This indicates that the spatial patterning of non-medical prescription opioid use may differ from that of other substances. However, a recent cross-sectional

study indicates that counties in the United States with high rates of treatment for alcohol and other illicit drug problems may also have greater rates of non-medical prescription opioid use (Wright et al., 2014), suggesting that there may be overlap between the non-medical prescription opioid and other substance use environments. It is unknown whether community level non-medical prescription opioid use contributes independently to rates of child maltreatment or injury. Better understanding of this relationship could allow for more targeted local prevention efforts to reduce non-medical prescription opioid use and subsequent community-level rates of child harm.

Our objective is to examine the relationship between non-medical prescription opioid use and child maltreatment and unintentional child injury in California zip codes between 2001 and 2011. To examine this, we use zip-code level prescription opioid overdose as a proxy for community non-medical prescription opioid use. We ask the following: Is the percentage of hospital discharges involving prescription opioid overdose associated with the number of hospital discharges for child maltreatment or unintentional injury?

2. Methods

We conducted analyses of all California zip codes in the years 2001–2011, resulting in 18,517 zip code year units. These data were used to examine the ecological associations between prescription opioid overdose, child maltreatment, and child unintentional injury, while controlling for indicators of other substance use and zip-code level environmental characteristics. Bayesian space-time misalignment models (Zhu et al., 2013; Ponicki et al., 2013) were used to account for changes in zip code boundaries over time, while also controlling for spatial autocorrelation.

2.1. Data sources and variables

2.1.1. Hospital discharge data. We used hospital discharge data obtained from the California Office of Statewide Health Planning and Development (which includes all California hospital discharges of at least 1 overnight stay) to obtain measures for zip code level child maltreatment, child unintentional injury, prescription opioid use (as measured by prescription opioid overdoses), and alcohol or other drug dependence. Each hospital discharge is coded by up to 5 ICD-9 E-codes which identify the causes of the injury, poisoning, or illness leading to hospitalization. Discharges may also be coded by V-codes, which designate other factors associated with the health and well-being of the patient. Discharges are identified by the residential zip code of the patient, and therefore represent hospitalizations for individuals living in a specific zip code in a particular year.

2.1.2. Child maltreatment. We measured child maltreatment as the annual count of hospital discharges for children aged 0–17 with codes of V612.1 (e.g., battering of child, child neglect), E967.0–E967.9 or E995.5 (e.g., assaults due to child abuse).

2.1.3. Child unintentional injury. We calculated the annual count of hospital discharges among children aged 0–17 due to the following unintentional injuries: transport accidents not related to motor vehicles (which may be more likely to occur due to insufficient adult supervision) (E800–E809.9, E826–E848.9), poisonings (E850–869.9), fires or accidental suffocations (E880–929.9), and other accidents (E980–989.9). We excluded injuries due to motor vehicle accidents (which may be less attributable to inadequate supervision) as well as those due to adverse reactions from a medication or medical procedure.

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