

Prepared by  
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# CHILD POVERTY, UNINTENTIONAL INJURIES AND FOODBORNE ILLNESS

Are Low-Income Children at Greater Risk?



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# Introduction

Unintentional injuries represent the leading cause of death for children between the ages of one and fourteen. They are responsible for approximately 5,000 child deaths, about 5 million child emergency room visits, and millions of unreported injuries each year. Approximately half of all reported foodborne illnesses occur in children under fifteen years of age, with children under five years of age at particular risk.<sup>1</sup>

A relatively high percentage of these children live in poverty. According to the Columbia University's National Center for Children in Poverty, of the 73 million children (ages 1-17) in the country, over two-fifths (44%) are from low-income families.<sup>2</sup> Because these children are more likely to experience unsafe environments such as deteriorated housing, unsafe playgrounds, lower nutritional status, and less parental supervision in one-parent homes, one would expect that they are subjected to greater injury-related risks than are other children.

Thus, it is surprising that the issue of low-income children suffering unintentional injuries and foodborne illness has received relatively little attention. In part because key databases on illness, injuries and related deaths do not contain information on household income or do not make connections between income and injuries, there are few recent studies on the subject. The greatest attention to the issue of unintentional injuries has been by emergency room physicians, pediatricians, and nurses, many of whom are associated with the Injury Free Coalition for Kids Network.<sup>3</sup>

While the federal agencies dealing with unintentional injuries and foodborne illness have not focused on those issues as they apply to low-income children specifically, there has been focus on minority communities.<sup>4</sup>

*Over two-fifths of the 73 million children in the United States are from low-income families.*

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<sup>1</sup> U.S. government data systems and academic research often use varying age ranges when providing data on injuries and foodborne illnesses for children, making direct comparisons difficult. For the purposes of this report and its recommendations, we are focusing on all low-income children, ages 1-17.

<sup>2</sup> The National Center for Children in Poverty points to research which suggests that families require an income equal to twice the federal poverty level to meet basic needs. Families below this level (\$29,420 for a family of two, \$44,700 for a family of four) are considered low-income.

<sup>3</sup> The Injury Free Coalition for Kids is an injury prevention program comprised of hospital-based, community-oriented programs, whose efforts are anchored in research, education, and advocacy. Currently, the coalition includes 42 sites located in 40 cities, each housed in the trauma centers of their participating institutions. More information is available at <http://www.injuryfree.org/about.cfm>.

<sup>4</sup> For example, in August 2009, as directed by the Consumer Product Safety Improvement Act, the Government Accountability Office published a report focusing on the U.S. Consumer Product Safety Commission and minority children. The report, titled, "Consumer Product Safety Commission: Better Data Collection and Assessment of Consumer Information Efforts Could Help Protect Minority Children" (available on the web at <http://www.gao.gov/new.items/d09731.pdf>) concluded that CPSC should improve its data collection system to more effectively include information about the race of the injured child and that CPSC should implement systems to assess whether safety messages were effectively reaching targeted populations. CPSC has responded to these recommendations and has modified National Electronic Injury Surveillance System to better capture data about race and has created a minority outreach team to evaluate and improve the effectiveness of safety messaging in minority communities.

In addition, the Department of Health and Human Services has created an "Action Plan to Reduce Racial and Ethnic Health Disparities" (available at [http://minorityhealth.hhs.gov/npa/files/Plans/HHS/HHS\\_Plan\\_complete.pdf](http://minorityhealth.hhs.gov/npa/files/Plans/HHS/HHS_Plan_complete.pdf)). This effort is based upon well-documented health disparities among racial and ethnic populations. Such differences are linked to "social, economic and environmental disadvantage." While this effort is focused on health disparities and not unintentional injuries, it represents a broad governmental effort to reduce health impacts in particular populations that could be used as a model to address unintentional injuries and foodborne illness.

*Existing data and research strongly suggest that low-income children are at greater risk than other children from unintentional injuries and foodborne illness.*

The purpose of this report is to show that existing data and research, however incomplete, strongly suggest that low-income children are at greater risk than other children from unintentional injuries and foodborne illness. These injuries are mainly incurred in the home, in the yard, on playgrounds, on streets, and in motor vehicles. The report will also explore reasons for these higher risks ranging from lack of information to hazardous environments. Finally, the report will discuss ways that federal safety-related databases can incorporate more information about socioeconomic status to allow researchers and practitioners to learn more about the influence of related factors.

The report, like existing data and research, is divided into two main sections – one on product-related unintentional injuries and the other on foodborne illness. Each section will discuss sources of information about injury or illness and related mortality, what these sources tell us about risks related to low-income children, what factors may help explain these risks, and what could be done to improve information sources.

## Unintentional Injuries

### Sources of Information

Two valuable national sources of statistical data about product-related injuries are the Consumer Product Safety Commission's (CPSC) National Electronic Injury Surveillance System (NEISS) and the Center for Disease Control and Prevention's (CDC) Web-based Injury Statistics Query and Reporting System (WISQARS). NEISS is administered by the CPSC and is based upon information received from selected hospitals across the country and U.S. territories. NEISS data is a probability sample based upon information collected at each participating emergency room about an injury or death associated with a consumer product. From the data collected through NEISS, national injury estimates are created. WISQARS is an online database compiled by CDC based upon data received by numerous sources that includes NEISS data, fatal and nonfatal injury data, violent death data, and cost of injury data. CDC statistics, noted in Table 1, indicate the most frequent causes of unintentional injury deaths of those between the ages of one and fourteen in the latest reported year. More than half of these deaths occurred in the "home environment." The mechanisms of death included fire or burn, drowning, suffocation, choking, unintentional firearm injuries, falls and poisoning (Nagaraja et al., 2005).

The CDC's National Center for Health Statistics publishes national estimates for a broad range of health measures, including injury data, based on the National Health Interview Survey (NHIS). While this annual report includes information about socioeconomic status, the report does not provide specific correlations between socioeconomic status of children and injuries.

**Table 1: Unintentional Injury Deaths in 2009**

Cause	1-4 yrs	5-9 yrs	10-14 yrs
Drowning	450	119	90
Motor vehicle traffic	362	378	491
Fire/Burn	169	88	53
Pedestrian, other transport	147	68	117
Suffocation	125	26	41
Fall	46	12	16
Poisoning	37	13	37
All other	130	71	193

Source: Morbidity and Mortality Weekly Report, Vital Signs: Unintentional Injury Deaths Among Persons Aged 0-19 Years-United States, 2000-2009, Centers for Disease Control and Prevention, April 16, 2012.

Both NEISS and WISQARS include information about age and race/ethnicity for different types of injuries. But neither provides data about income, local area, or reporting source. NHIS reports data on socioeconomic status, but the published survey does not provide correlations between injuries, age, and economic status.

More useful is scholarly research undertaken over the past three decades on the incidence of unintentional injuries. Most of this research is reported in journals such as the *New England Journal of Medicine*, the *Journal of the American Medical Association*, *Pediatrics*, *Injury Prevention*, and the *American Journal of Public Health*. While most of this research is not mainly intended to explore the relationship of income to child-related injuries, many of these studies do contain useful data on the subject. As will be seen, the researchers have utilized a diverse array of local, state, and federal information sources.

## Incidence of Death and Injury

**Deaths:** Existing data sources indicate that approximately 5,000 children die each year as a result of unintentional injury. Existing data, however, does not provide information about the economic status of those children who died. However, academic research provides important information. Much of the academic attention to the link between socioeconomic status and injury and death occurred three decades ago. For example, two relevant early studies from the 1980s focused attention on injury-related mortality. The advantage of this approach is that data on mortality are fairly complete. While there is some variation in how “causes” are reported, health care institutions and state registries include information about virtually all deaths. The disadvantage of focusing solely on mortality is that, for many products, there are insufficient numbers of deaths to permit reliable generalization. That is especially the case when a researcher studies a relatively small population, such as the residents of one community.

In 1985, Wise, Kotelchuck, Wilson & Mills published a study examining the relation of mortality to “socioeconomic disparities in childhood” that used Boston-related data from the Massachusetts’ Registry of Vital Events. In their analysis demonstrating that “childhood mortality was

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*Researchers found that “among the socioeconomic factors considered, low income was the single most important predictor of injuries.”*

significantly higher among black children and low-income children,” the researchers specifically found that injuries resulting from fires and occupant-related motor vehicle crashes were strongly related to lower incomes.

In the same year, Neresian, Petit, Shaper, Lemieux & Naor also published research on childhood mortality and poverty based on data from a different state. In reviewing all child deaths reported to the State of Maine from 1976 to 1980, the researchers learned that these deaths were experienced far more frequently by those children in families participating in social welfare programs than by those children who were not. In large part, these economic differences reflected disparities in injury-related deaths. Low-income children were well over twice as likely to experience accidental deaths as other children. In looking at specific causes, the study found that, comparing low-income children to other children, the rates for motor vehicle-related deaths were more than two to one, the rates for fire-related deaths were more than five to one, and the rates for drowning-related deaths were four to one.

**Injuries:** Existing national data sources document that unintentional injuries cause about 5 million children to be treated in emergency rooms each year and that there are many unreported injuries as well. Existing data about unintentional injuries does not, for the most part, include data about the income of the injured. However, academic research based upon smaller, more geographically focused data sources has found important connections between injury rates and income levels.

This research has more recently directed attention to all injuries, the large majority of which do not cause death. The great advantage of this broader focus is that the population studied is much larger. Many more children visit emergency rooms for treatment as die from injuries. However, the data on treatment can be less accurate than mortality statistics as indicators of incidence because of differences in access to emergency rooms and willingness to utilize this access (Scheidt et al., 1995).

In 1991, Santer and Stocking published the results of interviews with those receiving public assistance who were caregivers of young children enrolled in an inner-city pediatric clinic. These interviews revealed relatively low percentages of households with functional smoke alarms and fire extinguishers, with knowledge of ipecac, a remedy for poisoning, with adequately stored hazards, and with adequate child restraints in motor vehicles. The authors noted that “injuries...disproportionately affect poor children” and “specific concerns include exposure to fires and burns, falls, hazardous travel conditions, dangerous chemicals, choking, and drowning.”

In 1994, Durkin, Davidson, Kuhn, O’Connor & Barlow published a study of the risk of severe pediatric injury among children in a lower-income area in New York City. Using data collected by the Northern Manhattan Injury Surveillance System, the researchers found that “among the socioeconomic factors considered, low income was the single most important predictor of injuries.” While this conclusion included intentional as well as unintentional injuries, the researchers found higher rates of motor vehicle injuries, pedestrian injuries, fall injuries, and burn injuries in “largely low-income tracts” than in “moderately low-income tracts.”

In 2000, Danseco, Miller & Spicer reported research on the incidence of unintentional childhood injuries from 1987 to 1994 based on National Health Interview Survey data. Examining 3,073 injury episodes, the researchers learned that “children in families with incomes under \$5,000 had the highest rate of nonfatal injury” while “those in the highest income bracket had the lowest rate.”

In the same year, Grossman published a review of data and literature on the epidemiology of child and adolescent injuries. This article reported the finding by Danseco et al. that “overall, uninten-

tional injury rates are highest among adolescents ages 15 to 19, males, children from impoverished families, and minorities.” It also indicated that “higher rates of crash death are associated with residence in poor areas,” children in poor neighborhoods are at higher risk of pedestrian injury “primarily because of environmental risk factors, such as high traffic volume and lack of defined play areas,” and “the risk of drowning is twofold to fourfold higher among low-income families.”

In 2001, Pomerantz, Dowd, & Buncher published research on socioeconomic factors related to the admission of children suffering injuries to the Children’s Hospital Medical Center in Cincinnati. In comparing factors related to injury rates among census tracts, the researchers found that “the percentage of people living below poverty level, percentage of people with less than a high school education, and percentage of unemployment were all significant risk factors for injury.”

In 2002, Bishai et al. reported research on “injury in preschool children in an urban Medicaid managed care organization” in Baltimore from 1997 to 1999. Its conclusion based on this and other research was that: “Because the children in this study qualified for Medicaid, the high rates of injury may be related to poverty. Injuries disproportionately affect the poor and certain minority populations . . . Children enrolled in this urban Medicaid program had nearly twice the rate of injury when compared to the national average.”

A 2005 article published by physicians and others affiliated with the Injury Free Coalition for Kids found that “in low-income urban communities, injury rates . . . are higher than the national average” (Pressley et al., 2005).

**Traffic Injuries:** While most research on income and injuries has examined all causes of injuries suffered by children, there are studies specifically on “social differences in traffic injury risks” that were summarized in a 2000 literature review by Laflamme & Diderichsen. The reviewers’ general conclusion was that “for most types of traffic injury, mortality and morbidity are often higher among children from lower social positions and in more deprived socioeconomic areas.” More focused research in this area has also found that low-income child passengers are less likely to be restrained properly (Agran, Anderson, & Winn, 2004) and that “children who come from low-income families tend to live in dense, low-income, urban residential neighborhoods where they are at much higher risk of sustaining a pedestrian injury” (Committee on Injury, Violence, and Poison Prevention, 2009). However, other research found that children in low-income households were less likely to experience bicycle-related injuries (Scheidt et al., 1995) and occupant-related motor vehicle injuries (Wise et al., 1985), in part because these children were much less likely to ride on bikes and in cars.

**Fire Safety:** Research has also found significant income-related differences in fire deaths. An early study of house-fire deaths in Baltimore in the late 1970s compared the differences using census tract median rentals. Grouping the tracts into quintiles, it found that the death rates in the two lowest-rent quintiles were more than three times the rates in the two highest-rent quintiles (Mierley & Baker, 1983). In addition, Grossman, in a 2000 study, found that “poverty is strongly associated with the risk of death in a house fire,” likely due to the condition of the home which could include faulty heating systems, cigarette smokers, trailer homes, and absence of smoke alarms – conditions with a higher prevalence in low-income homes.

Further, an analysis of risk and protective factors for fires, burns, and carbon monoxide poisoning found that risk factors were more likely to be present in low- and moderate-income homes than in higher-income homes. Comparing households with incomes below and above \$50,000 using data gathered from a national telephone survey, the researchers learned that fire extinguishers, fire escape plans, and carbon monoxide alarms were much less likely to exist in the lower-income homes (Runyan et al., 2005).

*“For most types of traffic injury, mortality and morbidity are often higher among children from lower social positions and in more deprived socioeconomic areas.”*

*“Social disadvantage seems to be more important than ethnicity as a determinant of accidents to children in the home.”*

Correlating data from the U.S. Fire Administration’s State Fire Death Rates for 2009 with the Census geographical survey results indicates that of the ten states with the highest fire death rates, six of those states ranked at the highest level for children 18 years and younger living below the poverty level.

**Table 2: States with Highest Fire Death Rates**

States with Highest Rates of Child Poverty*		States with Highest Per Capita Fire Death Rate**	
Mississippi	32.5%	District of Columbia	33.4
District of Columbia	30.4%	Arkansas	28.7
New Mexico	30.0%	Mississippi	28.1
Alabama	27.7%	Alabama	21.2
Arkansas	27.6%	Oklahoma	21.2
Louisiana	27.3%	Missouri	20.2
Kentucky	26.3%	Tennessee	19.9
South Carolina	26.1%	West Virginia	19.8
Texas	25.7%	Kentucky	19.2
Tennessee	25.7%	Georgia	16.5

\*Related children 18 years and living below the poverty level, excluding Puerto Rico which would be ranked first at 56.3%; Source: U.S. Census Bureau, Child Poverty in the United States 2009 and 2010: Selected Race Groups and Hispanic Origin, American Community Survey Briefs, November 2011.

\*\*Per million population, Source: U.S. Fire Administration’s State Fire Death Rates, 2009 and US Census Bureau, 2006-2010

**Ethnicity:** The relationship of ethnicity to injury rates was the subject of other research. For example, one of the most comprehensive and recent studies (Pressley, Barlow, Kendig, & Paneth-Pollak, 2007) examined data from the National Vital Statistics registration system in all 50 states and the District of Columbia. It found that “Black and American Indian/Alaskan Native children had higher injury risk as a result of residential fire, suffocation, poisoning, falls, motor vehicle traffic, and firearms.” However, several researchers have found that ethnicity is a less important factor than income and other socioeconomic variables in predicting child injury rates. Grossman found that “some demographic characteristic, such as race, may be a marker for other underlying factors, such as poverty or education.” Bishai et al. have noted that “racial disparities seen in injury rates have been attributed to living in impoverished conditions rather than to ethnicity.” Alwash and McCarthy learned that “social disadvantage seems to be more important than ethnicity as a determinant of accidents to children in the home.” And Pomerantz et al. found that “factors correlated with race, such as poverty, education, and unemployment, rather than race itself, resulted in higher injury rates.”



## Factors Influencing Incidence

While most factors influencing the incidence of child injuries have not been carefully studied, there is some consensus among researchers that these factors are both environmental and human. One environmental factor relates to emergency and health services. Researchers have suggested that higher risks faced by low-income children could relate to the availability and/or quality of fire department, mobile emergency medical services, and emergency room services. Inadequately supported health and safety related services could well compromise access by low-income families – in rural areas, no convenient services at all, and in inner city urban areas, delays in medical treatment.

The condition of neighborhoods may also help explain income differences in child safety risks. “If poor neighborhoods have fewer safe play areas, more children are likely to play in the streets, abandoned buildings, and other hazardous areas” (Durkin et al., 1994). In the streets, children risk injury or even death from motor vehicles. And their playgrounds often have less safe equipment and surfaces than those available to children in higher-income families. In 1999, Suecoff and colleagues found that playgrounds in low-income neighborhoods in New York City had more maintenance related hazards than playgrounds in higher-income areas.

A third type of environmental factor is conditions in the homes where low-income children reside. These houses, and their appliances, tend to be older and less well-maintained, posing risks from hazards including fire, asphyxiation, falls, electrical shocks, and unsafe child products ranging from cribs to toys. It has already been noted that Grossman has found that children living in trailers face far higher fire risks than do those in other housing.

Other factors, though often influenced by the environment, are mainly human. Low-income parents are more likely to smoke than higher-income ones. That increases the risk not only of fires started by lit cigarettes but also burns caused by matches or lighters left around by smokers. Low-income parents also may be less able to afford child safety seats, smoke alarms, and other products that improve child safety.

Lack of knowledge also appears to play a role. In general, low-income parents may be less aware of the safety risks faced by their children and effective ways to mitigate these risks, for example, by keeping ipecac on hand to deal with poisoning, by installing and maintaining smoke alarms, by understanding the effective way to install a child safety seat, or being aware of recalls of unsafe child products. Research cited by Santer and Stocking supports the importance of parental awareness.

A final personal factor, noted by several researchers, relates to the relatively high percentage of low-income children in single-parent families. Regardless of how conscientious these parents are, they face significant challenges ensuring that their children are safe in and outside the home simply because, given the fact that the large majority work, they are less likely to be able to supervise their children than two parents who can better afford childcare. Given higher environmental risks their children face, and their own often severe time pressures, low-income single parents must frequently make a much greater personal effort to ensure the same level of child safety than their higher-income married counterparts.

*Durkin noted that “if poor neighborhoods have fewer safe play areas, more children are likely to play in the streets, abandoned buildings, and other hazardous areas.”*

*Single-parent families face significant challenges ensuring that their children are safe in and outside the home.*

*The CPSC and the CDC are in the best position to explore the feasibility of collecting information on income or census tract data.*

## Data Gaps

The research cited above strongly suggests that low-income children suffer greater risk of unintentional injury in general and suffer greater risks of several types of injury in particular. But it tells us very little about the role of socioeconomic factors in other types of injury – such as suffocation, poisoning, and falls – and in specific risks of current concern – such as furniture and television tip overs, window blind strangulation, button cell battery ingestion, all-terrain vehicle (ATV) safety, and sports-related helmet use.

However, research and action on these and other topics is handicapped by the absence of exact data on socioeconomic factors in the most important government databases – NEISS and WISQARS – and an absence of correlations between socioeconomic status, age and injury in databases such as NHIS where socioeconomic data is collected. It would be beneficial to researchers, practitioners, and support efforts if the CPSC and the CDC would take leadership in exploring the feasibility of collecting information on these factors and publishing such correlations.

The Institute of Medicine found similar data gaps in its 2004 report, “Children’s Health, the Nation’s Wealth: Assessing and Improving Child Health.” The Committee on Evaluation of Children’s Health stressed the importance of measuring minority and socioeconomic status in surveys and health records and ensuring consistency across measurement systems. The Committee recommended that, “Government and private agencies and academic organizations that conduct health-related surveys or compile administrative data should geocode addresses in ways that facilitate linkages to census-based and other neighborhood, community, city, and state data on environmental conditions” (National Research Council, 2004). The Committee further urged such data to be as accessible as possible, with adequate protections for confidentiality and security.

Most useful to identifying correlations between socioeconomic status, age, and injury would be to require reporting agencies, such as hospitals, to include information on family income of children suffering injuries. Almost as useful would be information on the census tracts in which the children live. There is research on a wide array of topics that utilizes census tracts as proxies for income. Less valuable, but possibly still useful for researchers, would be for the databases to include the sources of information. The geographic location of hospitals and other data sources would be a less reliable proxy for income than census tract residence of those injured, yet this information would permit researchers to focus on those hospitals providing medical services frequently to low-income children.

# Foodborne Illness

## Sources of Information

The most valuable source of statistical data about foodborne illness in the United States is FoodNet, the CDC’s national foodborne illness surveillance system. Based on data collected through FoodNet and other sources, the CDC estimates that 48 million Americans are sickened by foodborne illness each year (CDC, 2011), and that children under 15 years of age account for approximately half of all foodborne illness in the U.S. (CDC, 2009). Children under five are particularly vulnerable, experiencing the highest rates of infection for *Campylobacter*, *Salmonella*, *Shigella*, *E. coli* O157:H7 and other shiga-toxin producing *E. coli* bacteria (STEC) when compared to all other age categories. Scallen et al. estimates that five pathogenic bacteria cause 291,162 laboratory-confirmed illnesses each year among children under five years of age, resulting in 102,746 physician visits, 7,830 hospitalizations, and 64 deaths (Scallan et al., 2012).

*Children under 15 years of age account for approximately half of all foodborne illness in the U.S.*

**Table 3: Incidence\* of Selected Laboratory-Confirmed Infections in 2012 by Pathogen and Age Group**

Pathogen	<5 yrs	5-9 yrs	10-19 yrs	20-64 yrs	>65 yrs
<i>Campylobacter</i>	24.08	10.54	9.42	14.54	15.26
<i>Listeria</i>	0.17	0.00	0.03	0.17	1.05
<i>Salmonella</i>	63.49	19.33	11.26	12.15	17.22
<i>Shigella</i>	16.92	14.77	2.96	3.10	1.42
STEC O157**	4.71	2.31	1.65	0.58	0.74
STEC non-O157	4.81	1.33	1.65	0.70	0.92

\*Incidence per 100,000 population

\*\* Shiga toxin-producing *Escherichia coli*

Source: Foodborne Diseases Active Surveillance Network (FoodNet), Centers for Disease Control and Prevention, 2012

## Incidence of Foodborne Illness for Children Under Five Years of Age

Scholarly research has explored in more detail the incidence of specific foodborne infections, confirming the high rate of infection for children less than five years of age.

Vugia et al. reviewed FoodNet data from 1996 to 1999 and found that that incidence of invasive *Salmonella* infections was highest among male infants less than one year of age (9.4 cases/100,000). They also found that African Americans, Asians, and Hispanics had higher population-based incidences of invasive *Salmonella* infections than whites, possibly due to host factors and exposures particular to those populations such as foreign travel or eating certain ethnic foods (Vugia et al., 2004).

*Chai found that from 2004-2009, infections from Salmonella Enteritidis were highest among children four years of age and younger.*

*Low-income individuals tend to have poorer access to medical care, lower nutritional status, and greater exposure to environmental threats, which can impact their ability to fight foodborne infections.*

More recently, Chai et al. found that from 2004 to 2009, infections from *Salmonella Enteritidis* were highest among children four years of age and younger (4.7–6.9 cases/100,000). Chai identified an increase in incidence of 48 percent from 2004 to 2009 for children less than one year of age and an increase of 44 percent for children one to four years of age (Chai et al., 2012).

Samuel et al. found similar results in their 2004 review of FoodNet data on *Campylobacter* infections: the highest incidence of *Campylobacter* infections was in infants under one year of age (56.2 cases/100,000 population) and children aged 1–4 years (41.2 cases/100,000).

In 2012, Ong et al. reported a marked decline in the incidence of *Yersinia enterocolitica* among African-American children under five years of age. Likely modes of transmission were related to proximity of young children to food preparation or food preparers handling contaminated pork products. The study noted an 83 percent reduction in incidence from 1996 to 2009 in Georgia and suggested that targeted educational efforts in the state may have contributed to the decline.

In a separate study, Ong and colleagues reviewed the incidence of postdiarrheal hemolytic uremic syndrome (HUS) from 2000 to 2007. HUS is the most common cause of acute kidney failure among U.S. children and is most often a result of *E. coli* infection in young children. Ong found that 66 percent of HUS cases were in children younger than five years old (incidence rate of 1.9 cases/100,000); of those 64 percent were in children younger than two years (Ong et al., 2012).

Researchers and medical professionals generally agree that children are more susceptible to foodborne illness for several reasons. Children's immune systems are not yet fully developed so their ability to fight infection is reduced. Children have a lower body weight than adults which means a smaller dose of a pathogen can sicken them. They have limited control over their diet and related food safety risks. Finally, they have reduced stomach acid production which can sometimes kill harmful bacteria in adults (Center for Foodborne Illness Research & Prevention, 2009).

However, factors which might influence a greater susceptibility for low-income children are not well studied. The limited research available documents some environmental and human factors that could indicate an increased risk for foodborne illness for low-income populations. Other research highlights risk-taking behaviors of high-income populations and reporting biases which complicate correlations between income and increased risk of foodborne illness.

## **Socioeconomic Aspects of Incidence of Foodborne Illness**

Academic research has long highlighted a correlation between socioeconomic status and health (Feinstein, 1993). Several studies have found that at the individual, household, and community levels, economic deprivation increases the likelihood of bacterial, parasitic, and viral infections. A small number of studies in the U.S. and in other developed countries have found that people living in high-poverty areas experience higher rates of particular foodborne illnesses (Borgnolo et al., 1996; Bytzer et al., 2001). Low-income individuals also tend to have poorer access to medical care, lower nutritional status, and greater exposure to environmental threats which can impact their ability to fight foodborne infections (Klerman, 1991; Starfield, 1992).

Two additional studies demonstrate links between socioeconomic factors and foodborne illness. While these studies do not focus specifically on low-income children, they do point to a greater likelihood that children in low-income communities may be at greater risk for foodborne disease.

In 2009, Chang, Groseclose, Zaidi, & Braden conducted an ecological analysis of sociodemographic factors associated with the incidence of illness from *Salmonella*, *Shigella* and *E. coli* O157:H7 and found a “complex relationship between community characteristics and the dynam-

ics of disease transmission.” Particularly for salmonellosis and shigellosis, they found that “measures of race, ethnicity, place of residence, age group, poverty, unemployment, and urbanization” were the county-level characteristics most closely associated with incidence of these infections. The incidence of *Salmonella* infections was higher in communities with a higher percentage of children under five years of age, and in communities with more African American and Hispanic residents. The incidence of shigellosis was higher in communities with more children under five years of age, more residents living below the poverty level, and more Hispanic residents.

A 2010 study by Patrick, Zansky, Hurd, & Scallan surveyed parents of children younger than three years to identify risk factors for *Salmonella* and *Campylobacter* infections in infants. The study identified children who rode in shopping carts as most likely to be exposed to infection; however the researchers also identified income less than \$55,000 and Hispanic ethnicity as being associated with exposure.

## Factors Influencing Incidence

Much of the available research explicitly examining links between income and food safety has focused on identifying barriers to assuring safe food for low-income consumers. Limited research conducted on the microbial quality of food available to lower-income and minority populations in retail stores has found reduced access to safe food, particularly fresh produce, dairy, and eggs.

A 2011 study by Signs, Darcey, Carney, Evans, & Quinlan found that egg samples from low-income census tracts had higher internal temperatures and were more often unrefrigerated than eggs from high-income tracts. The same study found that milk samples from Hispanic and lower-income neighborhoods had a higher aerobic plate count (APC), an indicator of potential temperature abuse and shelf life, than milk in high-income areas. Ready-to-eat produce was more likely to be found in high-income census tracts, but when available in low-income areas, it had high rates of fecal coliform contamination.

In 2010, Koro, Anandan, & Quinlan found higher microbial indicator counts on produce in lower-income neighborhoods in Philadelphia. Higher rates of APC and yeast and mold were found on ready-to-eat greens and strawberries in addition to higher rates of yeast and mold on cucumbers, although no difference was found for microbial counts for broccoli, watermelon, orange juice or milk. Contamination rates for meat and poultry products studied were found to be similar in both low- and high-income census tracts.

Numerous studies, mainly in the nutrition field, have identified a lack of access to grocery stores and supermarkets in low-income areas (McKinnon et al., 2009; Moore & Diez Roux, 2006). Frequently, the predominant source of food items in these neighborhoods is small corner markets which are often challenged in assuring adequate food safety for the items they sell. Poor infrastructure, lack of refrigeration facilities, language barriers, pest infestation, limited resources, and small or undertrained staff have been identified as barriers to adequate food safety regulation compliance. Other barriers that have been identified include crime, employee turnover, a lack of trust in the regulations or compliance officers, and a lack of understanding of food safety regulations (Pothukuchi, Mohamed, & Gebben, 2008; Yapp & Fairman, 2006; Koro et al., 2010).

Retail food establishments such as fast food and carry out restaurants in low-income areas may also face challenges in maintaining adequate food safety. One study of inspection scores for retail food establishments in Detroit found that for each additional ten percent of individuals below the poverty line, there was an increase of 0.6 critical violations (Pothukuchi et al., 2008).

In 2011, Darcey and Quinlan found mixed results in an analysis of critical health code violation

*Researchers found that “measures of race, ethnicity, place of residence, age group, poverty, unemployment, and urbanization” were the county-level characteristics most closely associated with incidence of Salmonella and Shigella infections.*

*Egg samples from stores in low-income census tracts had higher internal temperatures and were more often unrefrigerated than eggs from stores in high-income tracts.*



*Residents in low-income neighborhoods who are uninsured may be reluctant to seek medical attention which means that illnesses from low-income populations may be underrepresented in foodborne illness statistics.*

rates of food service facilities in Philadelphia using Geographic Information Systems technology. Overall, food service facilities in high poverty areas had a greater number of facilities with at least one critical health code violation and had more frequent inspections than facilities in lower poverty areas. However, facilities in lower poverty areas had a higher average number of critical health code violations per inspection, possibly due to underlying factors affecting inspection frequency and subjectivity of health inspectors.

Another factor which may play a role in the risk of foodborne illness for low-income children is the level of safe food handling behaviors practiced in the home. Parents or caregivers of young children play a particularly important role as a parent's knowledge and practice of safe food handling can impact the likelihood that his/her children will acquire a foodborne illness.

Kwon and colleagues conducted a survey of participants in the Special Supplemental Women, Infants and Children (WIC) Program to assess food safety knowledge and food handling behaviors of low-income populations. They found that the least commonly reported safe food handling practices among low-income participants included refrigerating perishable foods within two hours of cooking, using a food thermometer, thawing foods safely, and properly sanitizing cutting boards (Kwon, Wilson, Bednar, & Kennon, 2008). These types of practices are not exclusive to low-income consumers; the FDA reports variation in safe food handling practices for all consumers in its regular safe food handling survey (Lando & Carlton, 2011). Barriers to proper food handling practices include a general lack of knowledge, difficulty changing habits because they are learned and practiced since childhood, lack of affordability, and difficulty changing food preparation routine (Trepka, Murunga, Cherry, Huffman & Dixon, 2006).

Complicating the limited research on the correlation between income and food safety are studies which indicate that groups with higher socioeconomic status are more likely to contract a foodborne pathogen or gastrointestinal illness. Researchers generally agree that such findings are most likely attributable to health-seeking behaviors of higher-income populations and greater access to health care services. Residents in low-income neighborhoods who are uninsured may be reluctant to seek medical attention which means that illnesses from low-income populations may be under-represented in foodborne illness statistics.

Younus and colleagues, using Geographic Information Systems technology to map trends in *Salmonella* infections in relation to neighborhood income levels in Michigan, found that residents of high education areas had higher rates of *Salmonella* infection. They suggested that residents in higher education blocks may seek medical care for even mild to moderate symptoms of illness which would increase the likelihood that their illness would be reported to the surveillance system (Younus et al., 2007).

Researchers also identify behavioral differences between high- and low-income groups. Higher-income consumers are more likely to consume higher-risk foods than their lower-income counterparts, particularly raw eggs, clams, oysters, fish and undercooked hamburger (Yang et al., 1998; Klontz, Timbo, Fein, & Levy, 1995; Roseman & Kurzynske, 2006). Raw or undercooked foods are more closely associated with foodborne illness because of the lack of an adequate cooking step which could kill pathogens that may be on or in the product. Fresh produce, which is often consumed raw and which has been linked to a number of foodborne illness outbreaks in recent years, is also consumed in greater levels by high-income populations than lower-income populations.

Higher-income consumers may not follow adequate food handling practices either. In a meta-analysis of studies of consumer food safety knowledge, Patil and colleagues found that high-income individuals reported greater consumption of raw foods, less knowledge of hygiene and poorer cross-contamination practices (Patil, Cates & Morales, 2005).

Higher-income consumers may adopt a more risk-taking approach to particular foods or have greater confidence in government and industry assurances of food safety. Lower-income consumers may be more likely, because of resource constraints, to purchase more canned fruits and vegetables and canned meats. Since these products are cooked they tend to be lower risk than raw food products, offering something of a protective effect from exposure to higher risk foods. However, it is important to note that ongoing efforts to increase access to and consumption of fresh fruits and vegetables among lower-income consumers for improved nutrition outcomes may alter this dynamic.

## Data Gaps

Younus and colleagues have noted that the lack of data on individual level socioeconomic factors in most U.S. disease surveillance systems “reduces the usefulness of surveillance data for these parameters,” such as household income, education or employment (Younus et al., 2007). The CDC collects basic demographic information in its foodborne disease surveillance system such as gender, age, ethnicity, and FoodNet location, but does not collect information on income, hindering the ability to analyze the impact of foodborne illness on populations of differing income levels.

Hospitals, medical providers, and state and local reporting agencies should be encouraged to collect data on income when cases of foodborne illness are diagnosed and reported. If privacy issues arise from collecting income information, zip code information, or other data verifying geographical location might be useful. Linking reported data to census tracts or census block groups could help researchers better understand the relationship between foodborne illness and socioeconomic status. While Geographic Information Systems technology has been used to map community disease risk and incidence within particular communities, for example, its use has been limited in research on foodborne illness and food safety (Darcey & Quinlan, 2011).

A more concerted effort to collect income data in foodborne illness surveillance systems could better inform researchers, policymakers, and other stakeholders about the particular risks facing low-income populations. Enhanced data about these populations could lead to more targeted, and hopefully more effective, approaches to reduce foodborne illness risk including policy changes, enforcement efforts and education campaigns.

## Summary and Implications

Research strongly suggests that, in general, children are at greater risk of product-related injury and foodborne illness than adults, and children from low-income households are at greater risk than other children. The most authoritative studies on the subject examine local or state sources of information about injury, illness, and related mortality. This research has found that low-income children are at greater risk not only from unintentional injuries generally but also from pedestrian, fire, burn, drowning, and fall injuries than are other children. The research also shows that low-income children may be more likely to be exposed to conditions associated with foodborne illness.

These potentially hazardous conditions are found in the home and in the community. Housing units tend to be older and less well-maintained, creating hazards including fire, asphyxiation, falls, electrical shocks, and unsafe children’s products ranging from cribs to toys. Play areas are less accessible and less safe. In urban areas, these areas include streets with inadequate traffic controls. Accessible food stores tend to be older and smaller, with less reliable refrigeration, poorer pest

*Hospitals, medical providers, and state and local reporting agencies should be encouraged to collect data on income when cases of foodborne illness are diagnosed and reported.*

*Research strongly suggests that, in general, children are at greater risk of product-related injury and foodborne illness than adults, and children from low-income households are at greater risk than other children.*

*National data collection efforts on unintentional injuries and foodborne illness could be expanded to include income or other data that could serve as a proxy for income so that the important connections between these factors can be better documented and understood.*

*Access to income-specific data would likely increase the effectiveness of policy changes, environmental interventions and educational efforts to prevent and reduce unintentional injuries and reduce illnesses caused by contaminated food.*

control, and less well-trained employees. In addition, medical care, in both rural and urban areas, can be less accessible.

These and other conditions contribute to factors more directly related to the children and their parents. Parents are less knowledgeable about childproofing a house from safety risks or preparing food safely. They are more likely to smoke, increasing fire and burn risks. And they may be less likely to seek prompt medical attention for injuries and illnesses.

## **Data Gaps Need to be Addressed**

A key finding from our review of the academic literature on unintentional injuries and foodborne illness is that significant data gaps exist. Academic researchers have documented increased risks of injury and foodborne illness to poorer children in a number of important studies, but broader national data connecting these two factors is unavailable. These gaps exist because the key databases on illness, injuries and related deaths either do not contain information on income or fail to include necessary correlations between socioeconomic status, age, and injury.

National data collection efforts on unintentional injuries and foodborne illness could be expanded to include income or other data that could serve as a proxy for income so that the important connections between these factors can be better documented and understood. Federal agencies such as the CDC and the CPSC should work with reporting institutions, state and local agencies and other entities to explore the feasibility of collecting this type of information. Such data could prove useful for researchers and practitioners to better understand the risks and related factors of injury and illness on low income populations in the U.S. The data could also point to new ways to reduce the incidence of injury and illness.

Our review of the literature also suggests opportunities for stakeholders, including health care professionals, health and safety organizations, low-income and minority groups, childrens' advocacy organizations, researchers, and regulators, to come together to systematically examine all potential sources of information regarding safety issues affecting low-income children. Prioritizing collection of additional data, seeking new ways of analyzing existing data, identifying potential solutions for mitigating hazards, and strengthening relationships among interested organizations would be the goal of such a convening. We hope that this report might spur creative collaborations and new engagements to raise awareness about the many safety impacts low-income children face and how best to prevent these impacts.

Traditional mechanisms for affecting change have included policy changes, home, environmental and community interventions, product redesign, and educational outreach efforts. Income-specific data would likely enhance the effectiveness of such efforts to prevent and reduce unintentional injuries and reduce illnesses caused by contaminated food. Activities could be better targeted based on the particular mechanism of injury or illness; specifically crafted to the population impacted; and delivered more effectively to the discrete target audience.

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