Comments Welcome

Accidents Will Happen?

Unintentional Childhood Injuries and Child Care Policy*

Janet Currie
UCLA and NBER

V. Joseph Hotz
UCLA and NBER

June 2001

*Anna Aizer, Jwahong Min, and Mehdi Farsi provided excellent research assistance. David Blau, Tor Eriksson, Jan Van Ours, and seminar participants at the Milan SOLE 2000 meetings and the University of Texas at Austin, Stanford, and the Child Care to Welfare Conference who provided helpful comments. The authors thank NICHD and NSF for financial support. The authors are solely responsible for the contents of the paper.

Abstract

Accidents are the leading cause of death and injury among children in the United States, far surpassing diseases as a health threat. We examine the effects of child care regulation on rates of accidental injury using both micro data from the National Longitudinal Survey of Youth, and Vital Statistics mortality records. Estimates from both data sources suggest that requiring care givers to have at least a high school education reduces the incidence of unintentional injuries. Specifically, these requirements reduce the probability of reporting an accident requiring medical attention by 72 percent. Turning to fatal accidents, our estimates imply that imposing minimum education requirements in jurisdictions without them would prevent 7.8 deaths per 100,000 children 0 to 4, compared to a baseline of 215 non-automobile passenger accidental deaths per 100,000 children in this age group. If 20 percent of accidental deaths among children in this age range occur in child care (as the best available evidence suggests) then our estimate suggests that 18 percent of these deaths could be prevented through higher educational standards.

An auxiliary analysis of the choice of child care mode suggests, however that higher educational requirements tend to crowd some children out of care, as do regulations requiring insurance and frequent inspections of child care facilities. Thus, regulation creates winners and losers: Some children benefit from safer environments, while those who are squeezed out of the regulated sector are placed at higher risk of injury.

Janet Currie
Dept. of Economics
UCLA and NBER
405 Hilgard Ave
Los Angeles CA 90095-1477
currie@simba.sscnet.ucla.edu

V. Joseph Hotz
Dept. of Economics
UCLA and NBER
405 Hilgard Ave
Los Angeles CA 90095-1477
hotz@econ.ucla.edu

1. Introduction

Accidents are the leading cause of death among children over 1 year old. Table 1 shows the six leading causes of death for children of ages 1 to 3, and 4 to 5, based on mortality data in 1996. As these figures make clear, unintentional injuries are a much more important cause of death among children than any form of infectious disease. Moreover, the incidence of mortality due to injuries represents only the tip of the iceberg with respect to their health consequences. For each death that results from childhood injury, it is estimated that there are more than 1,000 emergency room visits and an unknown number of injuries that receive no medical treatment (Children's Safety Network, 1991). Over the period 1987 to 1995, for example, there were an average of almost 9 million emergency room visits per year by children with preventable injuries and 12 million physician visits, with over 246,000 children per year who were actually hospitalized with such injuries (National SAFE KIDS Campaign, 2000).

A commonly held view is that childhood accidents just happen. For example, a 1999 Institute of Medicine Report on injury prevention remarks, "For centuries, human injuries have been regarded either as random and unavoidable occurrences ('accidents' or 'acts of God') or as untoward consequences of human malevolence or carelessness. From this perspective, the main strategies for prevention are prayer and human improvement" (Bonnie *et al*., 1999). This characterization of the determinants of accidents contrasts with a view that they are the result of choices, either implicit or explicit ones, made by parents, family, supervising adults and society about the extent to which children are exposed to risks of injury. For example, parents make choices about whether to place their infants and toddlers in car seats, whether to use safety caps on the containers of hazardous materials and where their children can play. And, as more and more mothers of young children have entered the labor force,[1] parents have increasingly made choices about the supervision that their children receive, and a corresponding risk of injury, by the choices they make among alternative child care arrangements.

In this paper, we examine the relationship between accidental injuries among young children and child care. In particular, we examine how the presence and stringency of alternative child care regulations affect the rates of accidents and mortality due to these accidents to young children in the U.S. As with other consumer products and services, government imposes various types of standards and regulations on child care arrangements. These include educational requirements of child care providers, maximum number of children per child care staff and whether providers/facilities are required to carry liability insurance. Most of these regulations are set at the state level and thus vary across states in the U.S. as well as over time. We exploit this variation in order to assess their impact on the incidence of accidents among children during the 1980s and 1990s. Information on state child care regulations was collected by Hotz and Kilburn (1997, 2000) and updated for this research.

To measure childhood accidents and mortality due to accidents, we use two sources of data. First, we use individual-level data on accidents requiring medical attention drawn from the National Longitudinal Survey of Youth's Child Mother (NLSYCM) file. Second, we analyze state-level, time-series data about accident rates constructed from the Vital Statistics Detail Mortality (VSDM) data, and Census population estimates from 1983 to 1998. Data on other characteristics of states are constructed from the March Current Population Surveys (CPS) and

[1] In the United States, the participation of women with children less than 6 years of age rose from 46.8% in 1980 to 62.3% in 1996 (U.S. Committee on Ways and Means, 1998). Despite the magnitude of these changes, we know little about their consequences for the well-being of children. Existing work has focused largely on effects of maternal employment on children's test scores (c.f. Desai et al., 1989; Parcel and Menaghan, 1994; Blau and Grossberg, 1992; Niedell, 2000; and Ruhm, 2000), with often inconclusive results. Accident rates may be more directly related to maternal employment at a point in time than test scores.

merged to the VSDM.

We find that regulations requiring care givers to have at least a high school education significantly reduce both fatal and nonfatal injuries. Specifically, requiring care givers to have at least high school is estimated to reduce the probability that a medically attended injury is reported by 72 %. Turning to fatal accidents, our estimates imply that imposing minimum education requirements in jurisdictions which lack them would prevent 7.8 deaths per 100,000 children ages 0 to 4, compared to a baseline of 215 non-automobile passenger related accidental deaths per 100,000 children in this age group. If 20% of accidental deaths among children in this age range occur in child care, as the best available evidence suggests, then our estimate suggests 18% of these deaths could be prevented through higher educational standards.

However, the consequences of these regulations are not without their costs. Evidence from an auxiliary analysis of the choice of child care mode suggests that the imposition of stiffer educational requirements do crowd some children out of regulated care by making this care more expensive. Requiring insurance and inspections also have similar consequences. As a result, some children in states with more stringent regulations are crowded, or priced, out of formal care, which tends to be safer than other child care arrangements. Thus, the use of regulations to improve the safety of child care settings can end up creating winners and losers, depending on whether the higher costs of regulations outweigh their beneficial quality-enhancing effects.

The rest of the paper is laid out as follows. Section 2 provides some background information about child care and injury risk. Section 3 lays out a conceptual model. Section 4 describes our data sources. Section 5 provides an overview of our empirical model. Results appear in Section 5 and Section 7 concludes.

2. Background Regarding Injury Risks and Child Care

There are several important trends and patterns in childhood accident rates. First, , the incidence of fatal accidents has been declining steadily both in the United States and in other OECD countries (UNICEF, 2000). Between 1987 and 1995, the number of deaths due to unintentional injuries among children younger than 14 in the U.S. fell from 15.6 per 100,000 to 11.5 per 100,000, a decline of 26 percent. This decline has occurred for many different types of accidental deaths (c.f. Glied, 1999). Second, childhood accidents tend to vary across demographic groups. For example, black children in the U.S. are 1.7 times more likely to die from unintentional injuries than are non-black children (National SAFE KIDS Campaign, 2000)

An important question is the extent to which the quality of child supervision plays a role in explaining accident rates. The majority of U.S. childhood accidents occur between May and August, and most unintentional injury related deaths among school aged children happen in the evening hours when children are most likely to be out of school and unsupervised. In addition, some types of injuries are most common among the children of single parents and young mothers (National SAFE KIDS Campaign, 2000).

The available evidence about child care and injury risk suggests two things. First, licensed, regulated, day care centers appear to be fairly safe places for children relative to other settings. Sacks *et al*. (1989) estimate that the risk of an injury requiring medical attention is 14.3 per 100 children annually in day care, compared to 35 per 100 children in the community at large. Similarly low rates of injuries have been found by other researchers (c.f. Briss *et al*.).

However, a second finding is that even regulated child care centers are often not as safe as they could be. Surprisingly, most states do not keep detailed information about deaths that occur in child care. However, projections based on states that do report suggest that 12% of the 2,260 accidental deaths to children 1 to 4 years old in 1995 may have occurred in child care settings. This figure rises to 20% if we exclude deaths to children who were automobile passengers from the denominator (U.S. News, 1997). Thus, deaths in child care account for a large fraction of total deaths, even if the majority of accidental deaths to children in this age range occur elsewhere. A recent report from the U.S. Consumer Product Safety Commission found that many licensed child care centers had safety hazards including unsafe equipment, a failure to use safety gates, window blind cords within children' reach, and allowing children to wear clothing with drawstrings (U.S. CPSC, 1999).

These findings suggest that there may be scope for reducing injury rates in licensed childcare settings through stricter regulation. However, many children are cared for in unregulated settings, and little is known about their safety. To the extent that regulation pushes children into hazardous, unregulated, child care arrangements, it could increase injury rates. These concerns about "crowd out" are explored more explicitly below.

3. Conceptual Model

In this section, we outline a simple model of parental choice over the production of "child quality"[2] and how restrictions on one set of inputs, child care, might be expected to affect those choices. Parents are assumed to maximize a utility function:

$$U = f(X, L, Q : c, e), \tag{1}$$

by choosing goods (*X*), leisure (*L*), and child quality (*Q*), taking child and family characteristics (*c*), and random shocks (*e*), as given. They maximize this function subject to the following budget constraint:

$$pX + wL = Y + (T - L)w, \tag{2}$$

where *w* is the wage, *p* is a vector of prices, *Y* is non-labor income, and *T* is the total endowment

[2] See Ribar (1992) and Blau and Hagy (1997) for similar models of parental labor supply and child care choice.

of time. Households also face a production function that describes the way that goods and non-working time (leisure) can be combined to produce child quality:

$$Q = g(X, L : c, v)\,, \tag{3}$$

where v is a random shock.

In this simple framework, child care is one of the X inputs into the production of child quality that can be purchased. It is useful to think of there being two types of child care, X_r which is regulated and X_u which is unregulated. These two forms of child care have prices p_r and p_u, respectively. To the extent that higher quality, and safer, child care is costly to produce, binding child care regulations that regulate quality and safety are likely to increase p_r relative to p_u. In a world of full information about child care settings and the risk of injuries to children, more stringent regulations will "price," or "crowd," some parents—namely those with a lower willingness to pay for higher quality care—"out" of regulated care.

However, it is reasonable to expect that parents may be uncertain about the quality of care their children will receive from a particular child care provider. For example, parents may not know exactly how attentive a provider is to their child or how safe a particular setting is. The imposition of minimum quality and safety standards on day care centers can solve the information problem faced by parents, at least to the extent that these standards are enforced. Some forms of regulation may actually change the production function for child quality, making it easier to avoid unintentional injury with a given level of parental effort. For example, a highly trained caregiver may be more likely than a less skilled person to educate parents about dangerous products and practices (such as drawstrings on children's clothing). A skilled caregiver is also more likely to teach children about safety practices proactively rather than punishing them after-the-fact for violating rules. As a result, such regulations may increase both the actual quality of care in the regulated sector and the amount that parents are willing to pay.

The potential for the imposition of minimum quality standards, via regulation, to solve the informational problems consumers face with respect to certain types of goods and services has been noted in the economics literature on product quality and liability. For example, Klein and Leffler (1981) argue that the maintenance of licensure systems that impose minimum quality standards on service providers may have beneficial welfare effects in markets for goods and services in which product quality is difficult to monitor. Imposing standards in such markets can "assure" consumers of the quality of the goods and services they receive to the extent that a provider's investment in meeting such standards either generates a higher stream of earnings or results in higher costs (fines) to the provider if these minimum standards are violated.[3]

In summary, regulating the child care market by imposing minimum standards on some segment of that market can be a two-edged sword. While children in child care settings subject to binding regulation may receive higher quality care, regulation is also likely to drive some children out of the regulated sector. Thus, the overall effect on child safety is ambiguous and a positive effect of regulation on accident rates may reflect this "crowd out" effect. We investigate this possibility further below.

4. Data

This study merges state-level data about child care regulations with individual-level data from the NLSY Child-Mother (NLSYCM) files as well as from the Vital Statistics Detailed Mortality (VSDM) data. In our view, these two sources of individual-level data are complementary. On the one hand, the NLSYCM has information about all medically attended

[3] Also see Leland (1979) and Shapiro (1986) for more on the role of licensing and imposing minimum quality standards in markets for goods and services with hard-to-monitor quality attributes. See Lowenstein and Tinnin (1992) and Hotz and Kilburn (1997, 2000) for more on the application of such arguments to the market for child care services.

injuries, rather than just the small fraction of injuries resulting in death. To our knowledge, this data has not previously been exploited. Moreover, the NLSYCM has a great deal of demographic information about mothers and children, as well as repeated observations on the same child. On the other hand, the NLSYCM data is reported by the mother, and is likely to be subject to reporting biases, as discussed below.

The VSDM is a census of all deaths, so selective reporting is not an issue. While the demographic information available is limited, data is available about both accidental and non-accidental deaths. We exploit the latter data to conduct specification tests of our results--regulation should affect deaths due to unintentional injuries without affecting other deaths. We also have information about the type of accident, so that we can identify at least one important type of accidental death that should not be directly affected by the regulation of child care centers, deaths to children riding as car passengers. Of course these deaths may be indirectly affected by child care regulation if regulations result in significant changes in commuting patterns but we expect this type of indirect effect to be smaller than the direct effects of regulation. Finally, the large sample sizes in the Vital Statistics data offer some distinct advantages, for example, much larger samples of African Americans. The remainder of this section gives further details about child care regulation, the NLSYCM, and the Vital Statistics data.

a) Data about Child Care Regulation

The child care regulations we focus on include ratios of children to care givers; whether there is more than one mandatory inspection per year of child care facilities; whether it is mandatory for child care providers to carry liability insurance; and whether child care providers are required to have at least a high school education. These forms of regulation tend to be applied to different types of child care settings. For example, direct inspections are generally used for licensed family homes while insurance is usually required only for day care centers. It is possible that this difference in regulations reflects the fact that large institutions find it easier to obtain insurance in the private market than small family home operations. Minimum education requirements also apply mainly to day care centers. We have coded these last three categories of regulation as '1' if the regulation applies to either family homes or to daycare centers. Regulation of child-to-staff ratios is prevalent for both day care centers and family homes. Hence we include measures for both types of child care setting. Further information about the collection of these data for each state and year are given in Hotz and Kilburn (1997,2000).

Table 2 provides a summary of the trends in several child care regulations for the period 1983-1998, the period covering the data on childhood accidents and deaths that we analyze. The Table shows the number of states that require child care providers in either setting to have at least a high school degree, whether the state requires that providers carry insurance, or whether the state has more than one required inspection per year. Mean maximum ratios of children to care givers for two age groups are also shown. Table 2 shows that on average, there was little change in these ratios over time, something that is also true within states.[4] At the same time, there are several noticeable changes in these regulations. First, between 1986 and 1987, 6 states added requirements that head child care providers have at least a high school degree. By 1991, 9 more states had added these requirements. Second, Table 2 indicates that there has been a slow decline in the use of direct inspections and an increase in the number of states that require at

[5] We also examined group sizes, which are often regulated. However, there is generally little difference between the maximum group size and the maximum ratio. Moreover ratios are a somewhat less ambiguous concept than the group size). For example, in California in 1996, a licensed family home with two care givers was allowed to have 12 children, including 4 infants and 8 older children. Here the ratio of children to care givers is clearly 6. However, the group size for infants is 4 and for toddlers is 8, even though all 12 children may be together for most of the day.

least some types of child care providers to carry insurance. Below, we assess whether these trends, and the across-state differences in regulations appear to have any effect on childhood accident rates and mortality associated with accidents.

b) Individual-Level Data

The National Longitudinal Survey of Youth began in 1978 with approximately 6,000 young men and 6,000 young women. These individuals have been followed up every year since. In 1986, the NLSY began following the children of the young women, at two year intervals. The National Longitudinal Survey of Youth's Child Mother (NLSYCM) data offers a unique and previously untapped source of information about medically attended, non-fatal injuries among children.

Questions about accidents were asked beginning with the 1988 survey. Mothers are asked: (1) whether the child had an accident in the past 12 months that required medical attention; and (2) whether the child ever had an accident (not necessarily in the past 12 months) requiring hospitalization. If the mother answered yes to either of these questions, she was asked the specific month and year of the *three most recent* accidents.[5] Because of the way that these questions were asked, we have accident information for different time windows for different children. For example, if the mother did not report any accidents in 1987, then we know nothing about 1986. But if she reported an accident in January 1987, and a previous accident in May 1986, then we have a history of accidents from May 1986 to December 1987. In total, we have accident data for 6,828 children aged 1 to 5. We excluded infants under one year because unlike older children, they are much more likely to die from essentially medical causes such as

[6] If there was an accident requiring medical attention reported in the same month and year as an accident requiring hospitalization, then we assumed that these were one and the same accident. While it would be interesting to look at accidents requiring hospitalization separately, the sample size is too small.

congenital anomalies. The NLSYMC files contain information on accidents covering the period 1983 to 1998. All children in our sample were surveyed at least once and some up to five times over this period. Organizing our data into quarters—because of the seasonal patterns in accident rates noted above, and so that we can more precisely measure the mother's work status—yields an average of 7.4 quarters of accident data per child.

We obtained data on maternal and child characteristics from the main NLSY and NLSYCM files. These variables include: the child's age, race, and gender; whether or not a spouse was present; whether there were older or younger siblings in the household; whether the maternal grandmother and grandfather worked when the mother was aged 14; the mother's score on the Armed Forces Qualifications Test (a test of job skills); and the mother's education. Some of these variables are likely to have a direct effect on accident rates. For example, the presence of an older sibling may mean that a child is more likely to be exposed to age-inappropriate toys. Other variables such as those describing the maternal grandparents and AFQT have been shown in previous work using the NLSY to be important correlates of maternal employment and socioeconomic status and may also be related to accident propensities.

Information about the mother's employment was obtained from the NLSY Work History file. The work history file has information about every mother's labor force status and usual hours of work for every week beginning with the first week of 1978. Mothers who reported working for at least one week during the quarter were coded as having worked during that quarter. We have a total of 50,384 quarters of child life data.

The NLSYCM surveys also included questions about child care in the 1986 and 1988 surveys which applied to the last month prior to the date of interview. Starting in 1992, questions were asked about child care in the first three years of each child's life. Because so little data was available about the child care of children over 3, we restrict this part of our analysis to children between 1 and 3 years. Our "child care" sample covers 14,366 quarters of child life. We use this subset of the sample to examine the effect of regulation on the choice of child care mode.

Descriptive statistics for the various NLSY data are presented in Table 3. In Panel A, we display the means for all of the variables we use for the entire NLSYCM sample, and by race and maternal education category. As one can see, the overall accident rate is 2.9% per quarter of child life, with a rate of 1.9% for blacks and 3.3% for whites. Accident rates increase slightly with the education of the mother, which is consistent with evidence from other sources that suggest socioeconomic biases in the reporting of medically-attended injuries. In particular, white mothers and more educated mothers are more likely to report medically attended injuries than their non-white and less-educated counterparts, even though we would expect their children to have lower actual injury rates. These reporting differences may either be because white/educated mothers are more likely to seek medical attention for an injury of a given severity to their child or because they are less likely to "forget" to report injuries. Similarly, more expensive day care centers and those with high proportions of white children are more likely to report such injuries, even though we would expect these centers to have lower actual injury rates. These differences in reporting provide important rationales both for stratifying the sample by race and education, and for including maternal fixed effects in our models, as discussed further below.

Maternal employment rates are high for all groups except high school dropouts, and increase with education. The other variables in Table 3 show largely the patterns that one would expect. For example, black children and children of high school dropouts appear to be disadvantaged in terms of maternal education and absence of a father-figure.

Panel B of Table 3 displays rates of unintentional injuries, maternal employment, and child and family characteristics by type of child care, for those mothers and children for whom we have child care information. Note, that this sample is much younger on average than the "accident" sample because of the way it is selected. Child care regulations generally distinguish between child care centers and licensed family homes. The NLSYCM data do not allow us to make this distinction. Unfortunately, the NLSY asks only whether a child was cared for in someone else's home, and not whether that home was a licensed child care setting. Given this limitation, we split the data into three groups: (1) nursery schools, day care centers, and preschools; (2) other types of child care; and (3) no non-maternal child care.[6] The first category is one that is very likely to be subject to regulation. The second category includes both licensed family homes, and other forms of non-maternal child care. Hence, it is difficult to tell whether children in the second category are affected by the regulation of family homes, though some children in this category must be.

There are two noteworthy patterns in the accident rates by mode of child care in Panel B of Table 3. First, accident rates are slightly lower for children in the most highly regulated child care settings than for children in the other two modes of care. Second, 43% of the mothers who report "no care" in a given quarter also report employment for at least one week in that quarter. It is possible that some of these mothers work shifts, or perhaps do not report father care as "child care." However, this finding suggests that there is some measurement error in responses to questions about the timing of work and child care decisions, as the information about these two sets of variables were gathered in two different parts of the survey.[7] Fortunately, the rates of

[6] A small number of children who are reported to be in "group homes" are also included in the preschool/nursery school/daycare category.

[7] Scott et al., (2001) and London et al. (2001) provide ethnographic evidence that suggests that many "welfare to work" mothers do in fact work non-standard shifts, and that very young children are frequently left in the care of somewhat older siblings. Using data from the National Survey of America's Families for 1999, Tout et al. find that

maternal employment are much higher for mothers who do report using child care, suggesting that there is some signal here.

b) Vital Statistics Data

The Vital Statistics Detail Mortality Files contain information about every death in the United States. The file has information about race, the state of birth, state of residence, age at death, and cause of death. We use data from the 1983 to 1998 files. In order to calculate a denominator to use in the computation of death rates, we use Census projections of the numbers of children in each state, year, race, and age group. Unfortunately, these data are not available over the entire period by single year of age. The age group that corresponds most closely to that used in our analysis of the NLSY data, is 0 to 4. We also will examine deaths among children, ages 5 to 9, as described further below, since we expect children in this age range to be less affected by child care regulation than younger children.[8] Calculating rates separately for 51 states, 16 years, 2 races and 2 age groups gives us 3,264 possible cells. In practice, there are 1,632 cells for whites, and 1284 cells for African Americans because for some states and years, no estimate of the number of black children is available, presumably because the numbers are so small. Hence, there are a total of 2,916 possible cells of data.

Following Glied (1999), these cells are matched to additional demographic data obtained from the Current Population Survey's March files (CPS). The Current Population Survey samples approximately 60,000 persons per year. We use these data to calculate, for each state

---

19% of 10-12 year old children are in "self care". This figure suggests that substantial numbers of young children may be left in the care of preteen or teenage siblings for at least part of the day.

[8] A previous version of this paper constructed rates for each single year of age by combining information from the Detail Natality files with information from the Detail Mortality files. Briefly, given the number of children born in a state, and the number of children who die in a state, one can come up with a rough estimate of the number of children of each age in each state and year. The limitations of this method are that a) it ignores immigrants, and b) it assumes that children are born and die in the same state.

and year, the fraction of children less than 16 who are in poverty, urban, black or Hispanic, as well as the median family income of the children, the fraction of children whose mother's have less than a high school education, the fraction of children in one parent families, and the fraction of children whose mothers were working for at least 20 hours per week. These variables are included in our analysis of accidental deaths in an attempt to control for time varying characteristics of states that might be correlated both with the passage of child care regulation legislation and with accident rates. Including the state and year dummies in our models will control for fixed characteristics of states and national trends. Of the 2,916 cells in the Vital Statistics data, 267 are missing information about child care regulations. These cells come primarily from the early years of our data and in many cases it was not possible to tell whether there was in fact a regulation or not. Thus, we conduct our analyses of accidental deaths using 2,649 cells.

Table 4 provides descriptive statistics for these Vital Statistics data. The first column shows the weighted mean computed over all cells, while the minimum and maximum counts across cells are shown in columns 2 and 3. We divided accidental deaths into three categories: those to children riding as car passengers, those to pedestrians from automobiles, and those not due to accidents involving an automobile. We also consider death rates due to cancer. We focus on these causes of childhood deaths for several reasons. First, all of them are quantitatively important. At the same time, we suspect that they differ with respect to their connections to child care arrangements. For example, we do not expect deaths to automobile passengers to occur primarily while children were in child care settings. We expect that childhood deaths due to cancer are even less likely to be influenced by the nature of child care arrangements and, thus, by the stringency of child care regulations. At the same time, accidents to children who are pedestrians are more likely to occur in unregulated child care settings—for example, while children are brought along while someone does errands—than in regulated care. Thus, examining the latter may give us a sense of the potential crowd out effects of child care regulations on childhood injury rates.

The summary statistics in Table 4 indicate that deaths due to unintentional injury among children are (mercifully) rare events. The overall rate is .261 per 1,000, which breaks down to .046 deaths per 1,000 to car passengers, .026 deaths per 1,000 attributable to pedestrians/car accidents, and .188 deaths per 1,000 due to all other causes. Cancer deaths are similar in importance to car passenger deaths with a rate of .045 per 1,000. Although it is not shown in the table, mean accident rates are higher for blacks than for whites, and higher for children, ages 0 to 4, than children, ages 5 to 9. The variation across cells in our CPS variables is also striking, with for example, poverty rates varying between 5% and 28%. However, small cell sizes in the CPS lead us to have some cells in which the share urban is either zero or 1.

Information on the number of observations per cell also are provided at the bottom of Table 4. As one can see, there is a good deal of variation in the sizes of cells in the vita statistics data we use, with the smallest cell having 199 observations and the largest having 2.6 million observations. Given this disparity in cell sizes, all of the estimates we produce below are derived from weighted regressions, where the weights are the cell sizes.

5. Empirical Methods and Identification Strategies

a) Estimation Using Individual-Level Data

We begin our analysis of the NLSYCM data by estimating Ordinary Least Squares (OLS) models of the following form:

$$\text{ACCIDENT}_{it} = \alpha_0 + \alpha_1' \text{CCREG}_{it} + \alpha_2' X_{it} + \alpha_3' \text{SEASON}_t + \alpha_{4t} \text{YEAR}_t + \varepsilon_{it}\,, \qquad (4)$$

where ACCIDENT is a dummy variable equal to 1 if child *i* had an accident requiring medical attention in quarter *t*; CCREG is a vector of variables describing the regulatory regime; *X* is a vector of child and household characteristics, such as maternal and child age; SEASON is a vector of dummy variables for the season of the year; and YEAR is a vector of year dummies. Since the child care regulations are determined at the state/year level, we will correct the standard errors for clustering.

There are several types of omitted variables that could bias our estimated effects of child care regulations, even in specification (4). First, there may be omitted characteristics of children and households that are correlated both with the child care regime and with accident rates due to geographical sorting of families. For example, parents in some parts of the country may be more aware of child safety issues than in other areas, and this in turn could be related to the probability that child care regulations are enacted. In this case, we would find a spurious negative correlation between child care regulations and accident rates. Second, child care regulations might be correlated with the probability that medical attention is sought for any given injury. For example, regulations may be more likely to be enacted in states that have better medical infrastructure. In this case, there would be a spurious positive correlation between accidents and injury rates. Finally, some parents may be more likely to seek medical attention than others for any given injury, and it is even possible that this effect is child specific. That is, a parent might systematically be more likely to seek medical attention for a frail child than for a more robust sibling.

In order to deal with these potential, as well as other, sources of bias, we also estimate models that include a child specific fixed effect. That is,

$$\text{ACCIDENT}_{it} = \alpha_i + \alpha_1'\text{CCREG}_{it} + \alpha_2' X_{it} + \alpha_3'\text{SEASON}_t + \alpha_{4t}\text{YEAR}_t + \varepsilon_{it}, \quad (5)$$

where α_i is a child specific fixed effect.

The effects of regulations in specification (5) are identified by following a specific child over time and asking whether changes in child care regulation affect the probability of an accident. Thus, they control for all unobserved characteristics of the policy environment, households, and children that are fixed over time. In particular, as long as the mother's propensity to seek medical attention for a given child (or to report that she did) is not affected by regulation, then fixed effects models offer a powerful way of controlling for individual differences in propensities to seek care and/or report.

One way to check on the plausibility of our findings is to recognize that child care regulations should have a greater impact on the children of employed mothers, than on the children of mothers who are not employed, since the former are more likely than the latter to use child care. Hence, we also present estimates for the following regression specifications:

$$\begin{aligned}\text{ACCIDENT}_{it} = {} & \gamma_i + \gamma_1'\text{CCREG}_{it} + \gamma_2\text{WORK}_{it} + \gamma_3'\text{CCREG}_{it}\cdot\text{WORK}_{it} + \gamma_4'X_{it} + \gamma_5'\text{SEASON}_t \\ & + \gamma_{6t}\text{YEAR}_t + \eta_{it},\end{aligned} \qquad (6)$$

where WORK is a dummy variable equal to one if the mother reports working more than one week during the quarter. We expect that the coefficients on the interaction terms will be larger in absolute value than those on CCREG.

The above three regression specifications are estimated for the entire sample, and for subsamples defined by race, education of the mother, and child age. We do so for several reasons. First, as discussed above, the reporting of injuries requiring medical attention in survey data may vary systematically by race and/or education. Including child fixed effects should control for this reporting bias, at least to the extent that mothers report injuries consistently over time. Second, it also is possible that there are real variations in the effects of regulation by race, education, or child age. For example, it may require more skill to prevent accidents among infants and toddlers, than to keep 4 year old children safe, and Table 3 suggests that blacks are relatively more likely than whites to use day care centers and preschools than other forms of non-maternal care, as are more educated mothers. Differences in the propensity to use different types of care are investigated further by using our "child care sample" to estimate multinomial logit models that show the log odds of choosing different types of care. These models are specified to be similar to equation (4).

b) Estimation Using Combined Vital Statistics and CPS Data

We use the combined Vital Statistics and CPS data to estimate models of the following form:

$$\begin{aligned}\text{ACCMORT}_{gst} = {} & \delta_i + \delta_1 \text{YOUNG}_{gst} + \delta_2 \text{BLACK}_{gst} + \delta_3' \text{CCREG}_{st} + \delta_4' \text{CCREG}_{st} \cdot \text{YOUNG}_{gst} \\ & + \delta_5' \text{CPS}_{st} + \delta_{6s} \text{STATE}_s + \delta_{7t} \text{YEAR}_t + \xi_{it}\end{aligned}, \qquad (7)$$

where g indexes the demographic group, s indexes the state, t indexes the year, ACCMORT is the mortality rate in the cell, YOUNG indicates that the group is 0 to 4, BLACK indicates that the group is black, CPS is a vector of other characteristics of states and years constructed using the CPS as described above, STATE is a vector of state dummies, YEAR is a vector of YEAR dummies, and u is an error term. All models are estimated by weighted least squares, where the weights are given by the cell sizes.

This model takes a "difference-in-differences" approach in identifying the effects of child care regulations on childhood accidents, where we use children, ages 5 to 9, as a control group that we hypothesize are not directly affected by these regulations. As we will show below using the NLSYCM data, the main effects of child care regulation are on children 1 to 3 years old rather than 4 and 5 year olds, supporting the above difference-in-difference identification strategy. If there are unmeasured characteristics of state and years that are associated with the passage of child care regulation, then these will be reflected in δ_3 , the vector of coefficients which measures the *effects* of child care regulation on 5 to 9 year old children. The true effects of regulation are then given by δ_4 , the vector of coefficients on the interaction of YOUNG and CCREG.

6. Estimation Results

a) Results Using NLSYCM Data

Table 5 shows OLS and fixed effects estimates of the effects of child care regulation for the regressions specifications in (4) and (5). The OLS estimates suggest that child care regulation has little effect on accident rates. The exception to this pattern is on the effect of requiring child care providers to have at least a high school education. This regulation is associated with a reduced probability of accidents which is significant at the 10% level in the whole sample, and at the 5% level in the sample of mothers with exactly 12 years of education. Most of the coefficients of the other variables follow the patterns one might expect on the basis of the epidemiological literature. For example, children with younger siblings are 6% less likely to have accidents, while boys are 9% more likely to have accidents than girls. Children of single mothers are also more likely to be at risk. The risk of accidents varies considerably by age, first rising as infants become toddlers, dipping briefly for 4 year olds and then rising again for 5 year olds. We also see the seasonal pattern that has been noted by others, with the lowest accident rates being in the winter quarter and the highest in the summer.

There are however, some coefficients that suggest the possibility of systematic differences in either the propensity to seek medical attention or reporting between groups. For example, black mothers are less likely to report accidents requiring medical attention, even though we know that black children are at much higher risk of accidental deaths than white children. Among black mothers, those with less than a high school education are the least likely to report accidents, while for white mothers, the reverse is true. Teenage black mothers are also less likely to report accidents than older mothers, although, once again, epidemiological evidence suggests that their children are at higher risk of accidents. Finally, conditional on education level, we see that among white mothers, women with higher AFQT scores are more likely to report accidents requiring medical attention. We believe that this result reflects a higher propensity to seek medical care for any given accident among these mothers.

As discussed above, child-specific fixed effects offer a powerful way to control for reporting differences among mothers. Fixed effects estimates of the effects of child care regulation for specification (5) are displayed in Panel A of Table 6. The estimated effects of minimum educational requirements are much larger in these models than found for the OLS estimates. In particular, we find that imposing an educational requirement on child care providers is associated with a reduction of 2.1% in the probability of accidents overall, which can be compared to the baseline of a 2.9% probability of accidents in Table 3. We also find that the effects of minimum educational requirements are larger for whites than for blacks—although the standard errors are large enough that we cannot reject the null hypothesis of similar effects—and for mothers who have at least a high school education as compared to those who are high school dropouts. Finally, the last two columns of the table show that the effect of education requirements is concentrated among children 1 to 3 years old, and that these requirements have little impact on 4 and 5 year olds.

The fixed effects estimates in Table 6 also provide evidence that regulations requiring frequent inspections reduce accident rates. The effect of requiring frequent inspections is significant (and large) in the whole sample, for mothers with at least some college, and for children, ages 1 to 3. Finally, when we break the sample into age groups we find small, but statistically significant, negative effects of higher ratios in day care centers on accident rates. The sign of this estimated effect is unexpected, unless one believes that higher ratios encourage people to "crowd in" to safer regulated care without having much effect on accident rates within day care centers. But, given the lack of variation in this variable within age groups within states, this estimate must be interpreted with some caution.

The contrast between the OLS and fixed effects estimates suggests that regulation is more common in places where mothers are more likely to report that children had accidents requiring medical attention. As discussed above, this might be because the children are more likely to actually have accidents, because the mothers are more likely to seek medical attention for any given accident, or because the mothers are more likely to recall/report the incidents.

The fixed effects estimates that allow the effects of regulation to vary by the mother's working status—see specification (6)—are displayed in Panel B of Table 6. Where there is an effect of minimum education requirements, the effect is much larger for children whose mothers are working than for other children. Our estimates for whites, mothers with at least some college, and for younger children all suggest that maternal employment increases the probability of accidents requiring medical attention in states without minimum education requirements. However, in states with minimum education requirements, maternal employment has no overall effect. These estimates suggest that the effects of maternal employment on child well-being are likely to depend on the quality of substitute care giving, which in turn is affected by child care regulation.

As in Panel A, the estimated effect of requiring frequent inspections displayed in Panel B of Table 6 is to reduce accident rates among 1 to 3 year old children, but this effect is the same for children of both working and non-working mothers. Similarly, higher ratios in day care centers are estimated to reduce accident rates for both sets of children. Thus, it is possible that these estimated effects reflect unmeasured characteristic of states and years that are associated with the frequency of inspections and ratios in day care centers rather than causal effects of regulation. Frequent inspections are also estimated to *increase* accident rates among children of working high school dropouts. It is possible that this represents children being crowded out of regulated care, since any increases in the price of care that are caused by regulation should have their greatest impact on low wage working mothers.

b) Regulation and the Choice of Child Care Mode

We present results in Table 7 that further explore the issue of the potential crowd out effects of more stringent regulations on child care utilization. Therein, we present estimates for a multinomial logit model in which we estimate the effects of our regulation variables on the log-odds of the child care mode choices parents made for the children of the NLSYCM sample.[9] The estimates show that imposing minimum educational requirements on child care providers reduce the probability that white children and children of more educated mothers are enrolled in day care centers and preschools. These requirements have positive, but not statistically significant effects, on the probability that children are cared for in other child care settings, which makes sense since minimum education and insurance requirements generally do not apply to other settings.

---

[9] The specifications of the payoff equations for child care modes are similar to those in equation (4), except that they include annual time trends rather than year dummies. Also, it was not possible to estimate this model for the sample of high school dropouts, given the small sample size (1,610 quarterly observations). Estimates from a simpler model for this sub-sample (one that omitted child age dummies), indicated that none of the child care regulations had statistically significant effects, but it is impossible to be sure that this result is not an artifact of the small sample size.

Requiring frequent inspections of child care facilities are estimated to reduce the probability that black children receive any child care, but this effect is not statistically significant in other sub groups. Requiring insurance reduces the probability that day care centers and preschools are used in every group. Requiring insurance has much weaker effects on the probability that other forms of child care are used in every group, though the effect is only statistically significant among blacks. This result is also to be expected given that informal child care settings are less likely to be subject to insurance requirements than day care centers and preschools. Finally, we find that allowing higher ratios of children to caregivers in day care centers increases the probability that day care centers and preschools are used.

The coefficients on other variables are broadly consistent with what one might expect given the existing literature on choice of child care modes. More educated mothers are more likely to use center-based care, and within education groups, higher AFQT mothers are also. Children with either older or younger siblings are less likely to use any form of child care, suggesting that *only* children are more likely to be in such care. Black children are more likely to use center-based care than other children, and Hispanic children are more likely to use such care than other whites.

In summary, the results so far paint an remarkably consistent picture of the effects of minimum education requirements. Requiring care givers to have at least a high school education reduces accident rates. This effect is concentrated among children, ages 1 to 3, and among mothers with high school education or more. The estimated coefficients are much larger among children of working mothers than among children of non-working mothers, as one would expect if they measure a causal effect of child care regulation. However, education requirements tend to crowd white children and children of more educated mothers out of day care centers and preschools. In contrast, regulations requiring inspections, insurance, and reducing child/staff ratios all appear to crowd children out of regulated care, without having a consistently estimated causal impact on accident rates. Some of these regulations have differential impacts on certain groups. For example, regulations requiring inspections crowd black children out of all forms of child care but appear to have little effect on white children. In general, policy measures targeted directly at assuring the safety of child care settings—such as inspections and insurance—seem to have a smaller effect on accident rates than general education requirements, which is ironic given that education requirements are generally aimed at improving children's cognitive skills rather than reducing accidents.

c) Results Using Vital Statistics Data

Models based on the specification in (7) estimated using the aggregate Vital Statistics data are shown in Table 8. Our main concern here is to verify whether the patterns we obtained for medically attended injuries in the NLSYCM data are consistent with those derived for the more objectively reported Vital Statistics data. The table shows the determinants of death rates from all accidents that are not car related, accidents to car passengers, car-pedestrian accidents, and cancer. As discussed above, we include cancer deaths as controls as one would not expect them to be affected by child care regulation. We expect child care regulation to have causal effects on 1 to 4 year olds, but not on 5 to 9 year olds. Our stratifications of the NLSYCM data by age support the idea that these regulations should have little effect on children older than 3. Thus, our main focus is on the interaction between "YOUNG" and the child care regulations.

The first panel shows that in the entire sample, the coefficient on the interaction between YOUNG and minimum education requirements is negative and statistically significant for non-car accidents. The interaction is not significant in models of car passenger deaths or cancer deaths, but has a significant and positive coefficient on car-pedestrian deaths. If we assume that car-pedestrian deaths are much less likely to occur while children are being cared for in formal settings such as day care centers and preschools than they are to occur while children are being cared for in informal settings, then this result suggests that minimum education requirements are associated with a decline in deaths in formal settings which is partially offset by increases in deaths among children who are crowded out. The net effect is a reduction of 7.8 deaths per 100,000. As discussed above, comparing this reduction to a baseline of 215 accidental deaths (excluding those to automobile passengers) per 100,000 per year in this 0 to 4 year old group, and assuming that 20% of these deaths occur while children are in care, implies that minimum education requirements could reduce child care-related deaths by 18%.

The interactions between YOUNG and frequent inspections, and between YOUNG and requiring insurance are positive for non-car accidents. Consistent with our results from the NLSYCM, this estimate suggests that requiring insurance and frequent inspections cause crowd out without having much of an impact on injury rates in child care centers. Finally, the interaction between the child/staff ratio in day care centers and YOUNG is positive and statistically significant in the model of non-car deaths. The point estimate implies that reducing the ratio by 1 would decrease the number of deaths per 100,000 child years by 3. However, given our results from the NLSYCM data, which suggested that higher ratios reduce accident rates, evidence from both data sources that legislation affecting ratios may be affected by accident rates (see below), and the small amount of variation in these ratios within states and age groups, we believe that this possible effect merits further investigation before strong conclusions can be drawn. The interaction between YOUNG and day care ratios is also significant and positive in the model of car passenger deaths, though it is very small (the estimate implies an additional .9

deaths per 100,000 child years for a one unit increase in the ratio). This estimate could reflect people being more likely to drive their children to centers when ratios are higher (and prices are lower).

The main effects of regulation in these regressions are also of interest, since they may give some insight into the characteristics of states and years in which regulations are passed. The main effect of frequent inspections is negative and statistically significant in both models of non-car accidents and in models of cancer deaths. These estimates suggest that states and years with lower accident rates and lower rates of cancer deaths (perhaps because they have better medical facilities?) are more likely to have laws mandating frequent inspections of child care centers. Thus, these results confirm our suspicion that the estimated effects of inspections in models estimated using NLSYCM data reflect endogeneity of the legislation rather than causal effects of this regulation. The main effect of higher day care ratios is also estimated to be negative in models of non-car accidents, suggesting that places with lower accident rates tend to allow higher ratios. Finally, the main effects of educational requirements are statistically insignificant, except in the models of car-pedestrian deaths. Here, the coefficient is negative suggesting that places with fewer car-pedestrian deaths (because of less congestion?) are more likely to implement these requirements.

The control variables constructed using the CPS are generally not statistically significant. Exceptions are that the fraction of children with working mothers in the state and year is positively related to cancer deaths, and the fraction of children in poverty is negatively related to car passenger deaths. Since it is unlikely that either of these effects is causal (though the fraction in poverty may pick up limited access to automobiles), these results suggest that it may be difficult to control for time-varying state characteristics that may be correlated with accident rates using aggregate CPS data. It is for this reason that we emphasize the difference-in-difference results comparing effects on 0 to 4 year old children with effects on other children, and comparing results for accidents to those for cancer deaths.

7. Discussion and Conclusions

We find consistent evidence that requiring head care givers to have high school education reduces accident rates. In the NLSYCM, we find that accidents requiring medical attention are reduced for all children, though effects are stronger among children 1 to 3, and among mothers with high school education or more. The estimated coefficients are much larger among children of working mothers than among children of non-working mothers, as one would expect if they measure a causal effect of child care regulation. Estimates obtained using the Vital Statistics data indicate that minimum educational requirements in day care centers reduce accidental deaths. Moreover, the magnitudes of the effects in the two data sets are remarkably consistent with the "pyramid of injuries" described in the first paragraph of the paper. Recall that the 6,600 accidental deaths among children each year were associated with 12 million doctor visits for medically attended injuries. These numbers imply a ratio of .00067 deaths per medically attended injury. Our estimated effects of minimum education requirements imply a ratio of .00055 deaths prevented for each injury prevented.

However, we also find that child care regulation crowds some children out of regulated care, and that crowd out associated with minimum education requirements is associated with an increase in car-pedestrian deaths that partially offsets the decrease in non-car deaths. Requiring insurance and/or frequent inspections does not reduce accident rates, and may even increase them by crowding children out of regulated care. Thus, policy measures targeted directly at assuring child safety (such as inspections and insurance) have a smaller effect on accident rates outcome than general education requirements.

Increasing the education of child care workers is likely to be a costly policy. The median hourly wage for women without a high school education was $6.00 in 1998 compared to $8.61 for women with a high school education. Our estimates imply that in a group of 100,000 children, imposing minimum education requirements would reduce the number of accidents requiring medical attention by 8,352, and the number of deaths by 7.8. Given a mean child-staff ratio of 8.5 for children 1 to 3, it would take 11,765 teachers to look after these children. Suppose that half of these teachers are "head" teachers (for example, in a group of 17 children there might be one head teacher and one assistant teacher). If it was necessary to raise the wages of all of these head teachers by $2.61 per hour, and they worked 2,000 hours per year, then implementing the minimum education policy would cost $30.7 million per 100,000 children. This is likely to be a high estimate of costs, given that there will be some head teachers with at least high school educations even in the absence of minimum education requirements. This estimate implies that the cost per life saved through education requirements is $3.9 million, which is in the same ball park as the costs of other regulations aimed at saving children's lives (c.f. Tengs et al., 1995).

But minimum education requirements also bring other benefits. According to the National Safe Kids Campaign (2000), the average accident entails $650 in medical costs, and $1,000 in foregone wages. Reductions in these costs would offset $19.2 million of the $30.7 million in increased teacher wage costs. Moreover, the main impetus for minimum education requirements is concern about children's cognitive development rather than concern with their physical safety. Many studies suggest that more educated care givers give more developmentally appropriate and cognitively stimulating care than less educated care givers (c.f. NICHD Early

Child Care Research Network, 1999). Thus, a complete cost-benefit accounting would have to place a dollar figure on these benefits. Still, even if the policy were found to be cost effective, it might not be the best possible policy given the adverse effects on children who are crowded out.

Our results indicate that the when it comes to child care regulation, the “cup” may be regarded as half empty or half full. On the one hand, some forms of regulation that are directly aimed at improving child safety have unintended negative effects and may do more harm than good. They appear to reduce child safety by crowding children out of regulated care. On the other hand, minimum education requirements have large positive overall effects on child safety among the children who are fortunate enough to benefit from them, even though they have negative consequences for the children who are crowded out of regulated care. These requirements may also have benefits in terms of children’s cognitive skills and future development, though these benefits are as yet largely unmeasured.

References

Blau, David and Alison Hagy. "The Demand for Quality in Child Care," Journal of Political Economy, 106 #1, February 104-146.

Blau, Francine and Adam Grossberg. "Maternal Labor Supply and Children's Cognitive Development," Review of Economics and Statistics, 74(3), August, 1992.

Bonnie, Richard J., Carolyn E. Fulco, and Catharyn T. Liverman (eds.), Reducing the Burden of Injury, (National Academy Press: Washington D.C.) 1999, page 20.

Briss, Peter A., Jeffrey Sacks, David G. Addiss, Marcie-jo Kresnow and Joann O'Neil. "A Nationwide Study of the Risk of Injury Associated with Day Care Center Attendance," Pediatrics 93 #3, March 1994, 364-368.

Children's Safety Network, A Data Book on Child and Adolescent Injury, (Washington, D.C.: National Center for Education in Maternal and Child Health, 1991).

Desai, Sonalde, Lindsay Chase-Lansdale and Robert Michael. "Mother or Market? Effects of Maternal Employment on the Intellectual Ability of 4-Year Old Children," Demography, 26, 1989.

Glied, Sherry. "The Value of Reductions in Child Injury Mortality in the U.S.," NBER Working Paper #7204, July 1999.

Hotz, V. Joseph and Rebecca Kilburn. "Regulating Child Care: The Effects of State Regulations on Child Care Demand and its Cost," xerox, Dept. of Economics, University of Chicago, October 1997.

Hotz, V. Joseph and Rebecca Kilburn. "The Effects of State Regulations on Child Care Prices and Choices," xerox, Dept. of Economics UCLA, March 2000.

Klein, Benjamin and Keith Leffler. "The Role of Market Forces in Assuring Contractual Performance," Journal of Political Economy, 89, 1981, 615-641.

Leland, Hayed. "Quacks, Lemons, and Licensing: A Theory of Minimum Quality Standards," Journal of Political Economy, 87, 1981, 1328-1346

London, Andrew, Ellen Scott, Kathryn Edin, Vicki Hunter. "Ethnographic Perspectives on Welfare to Work Transitions, Work-Family Tradeoffs, and Children's Well-Being," paper presented at the 22nd Annual Research Conference of the Association for Public Policy Analysis and Management, Nov. 2-4, 2000.

Lowenberg. A. and T. Tinnin. "Professional versus Consumer Interests in Regulation: The Case of the U.S. Child Care Industry," Applied Economics, 24, 1992, 571-580.

National SAFE KIDS Campaign, Statistical Fact Sheets on Childhood Injuries (Washington D.C., 2000).

Neidell, Matthew. “Early Time Investments in Children’s Human Capital Development: Effects of Time in the First Year on Cognitive and Non-Cognitive Outcomes,” Dept. of Economics UCLA, xerox, October 2000.

NICHD Early Child Care Research Network. “Child Outcomes When Child Care Center Classes Meet Recommended Stadards of Quality” American Journal of Public Health, 89, 1999, 1072-1077.

Parcel Toby and Elizabeth Menaghan. Parent’s Jobs and Children’s Lives (New York: Aldine de Gruyter) 1994.

Ruhm, Christopher. “Parental Employment and Child Cognitive Development” (NBER: Cambridge MA) Working Paper # 7666, April 2000.

Sacks, Jeffrey J, J. David Smith, Karen Kaplan, Deborah Lambert, Richard Sattin, Keith Sikes. “The Epidemiology of Injuries in Atlanta Day-Care Centers,” Journal of the American Medical Association, 262 #12, Sept 22/29, 1989, 1641-1645.

Scott, Ellen, Kathryn Edin, Andrew London, and Rebecca Kissane. “Child Well-Being and Family Management in the Transition from Welfare to Work,” xerox, Dept. of Sociology, Kent State University, May 2001.

Shapiro, Carl. “Investment, Moral Hazard, and Occupational Licensing,” Review of Economic Studies, LIII, 1986, 843-862.

Tengs, Tammy et al. “Five Hundred Life Saving Interventions and Their Cost-Effectiveness,” Risk Analysis, 15, 1995, 369-390.

Tout

Unicef, A League Table of Child Daths by Injury in Rich Nations (Innocenti Foundation, Florence) 2000.

U.S. Committee on Ways and Means, Green Book (U.S. Government Printing Office, Washington D.C.) 1998.

U.S. Consumer Product Safety Commission. “Safety Hazards in Child Care Settings” (CPSC: Washington D.C.) April 1999.

U.S. National Center for Health Statistics, National Mortality Detail File (NCHS: Washington D.C.), multiple years.

U.S. News. “Day Care Dangers,” www.usnews.com, August 4, 1997.

Williams, Bret C., and C. Arden Miller, “Preventive Health Care for Young Children,” Pediatrics, 89 #5 (May 1992 supplement) 982-998.

Table 1: Six Leading Causes of Child Death in the U.S., 1996, By Age

	1-3 Year Olds:		*4 and 5 Year Olds:*	
Ranking	***Cause***	***No. of Deaths***	***Cause***	***No. of Deaths***
1	Unintentional Injuries	1,798	Unintentional Injuries	1,162
2	Congenital or Perinatal Problem	636	Cancer	384
3	Homicide or Assault	362	Congenital or Perinatal Problem	194
4	Cancer	362	Disorders of Nervous and Sense Organs	182
5	Disorders of Nervous and Sense Organs	349	Infectious and Parasitic Diseases	158
6	Infectious and Parasitic Diseases	327	Homicide or Assault	149

Notes: The number of deaths to U.S. born children appears in parentheses. We estimate that in 1996 there were 11,751,692 U.S. born children between 1 and 3, and 8,092,613 between the ages of 4 and 5.

Table 2: Variation in Child Care Regulations, 1983-98

Year	***Number of States with:***						
	Minimum Education Standards	*More than One Inspection Required per Year*	*Insurance Required*	*Child-to-Staff Ratio, Day Care, Child 1-3*	*Child-to-Staff Ratio, Day Care, Child 4-5*	*Child-to-Staff Ratio, Family Homes, Child 1-3*	*Child-to-Staff Ratio, Family Homes, Child 4-5*
1983	26	13	17	8.5	14.7	5.6	6.4
1984	28	13	19	8.4	14.5	5.6	6.4
1985	29	14	19	8.5	14.6	5.6	6.4
1986	30	16	20	8.3	14.5	5.6	6.5
1987	36	14	21	8.2	14.1	5.6	6.6
1988	37	13	21	8.3	14.3	5.5	6.5
1989	37	13	21	8.3	14.3	5.6	6.7
1990	40	13	21	8.3	14.3	5.6	6.7
1991	45	12	22	8.3	14.4	5.6	6.8
1992	45	12	22	8.2	14.4	5.6	6.8
1993	47	11	22	8.2	14.4	5.7	6.9
1994	47	11	22	8.2	14.4	5.7	6.9
1995	47	11	22	8.2	14.3	5.7	6.9
1996	47	11	21	8.2	14.3	5.7	6.9
1997	48	12	21	8.2	14.3	5.7	6.9
1998	50	12	21	8.2	14.4	5.7	6.9

Notes: Minimum education required indicates that head caregivers in either family homes or day care centers must have more than a high school degree. The “insurance required” and “number of inspections > 1” variables are coded one if either family homes or day care centers are subject to these regulations.

Table 3: Sample Means for NLSY Data

Panel A: By Race and Education

Variables	*All*	*Black*	*White*	*< HS*	*HS*	*Any College*	*Children Ages 1-3*	*Children Ages 4-5*
Accident Rate	.029	.019	.033	.026	.030	.030	.032	.027
Maternal Employment	.612	.602	.616	.337	.590	.708	.604	.622
Child Age	3.16	3.23	3.13	3.29	3.21	3.08	2.04	4.54
Child Male	.508	.498	.511	.521	.501	.510	.509	.506
Hispanic	.204		.279	.364	.192	.171	.200	.208
Black	.271	1.0		.317	.277	.252	.259	.286
Mother's Age	31.0	30.5	31.2	29.7	30.5	31.8	30.8	31.3
Mother Single	.307	.588	.202	.520	.344	.252	.280	.340
Younger Sib.	.228	.224	.230	.282	.221	.220	.146	.330
Older Sib.	.467	.529	.444	.619	.498	.396	.495	.431
Maternal Grandma work	.511	.561	.492	.415	.503	.544	.513	.508
Maternal Grandpa work	.739	.560	.805	.582	.728	.792	.745	.731
Maternal Grandma Ed.	10.6	10.6	10.6	8.1	10.1	11.7	10.7	10.5
Mother's Education	13.0	12.8	13.1	9.3	12.	15.0	13.1	12.8
AFQT score	37.7	20.7	44.0	11.0	29.3	52.8	38.9	36.1
No. of Obs.	50,384	13,646	36,733	6,196	21,460	22,728	27,882	22,502
No. of Children	6,828	1,817	5,011	936	2,943	2,949	5,520	5,632

Panel B: By Child Care Mode (Selected Variables)

Variables	*No Child Care*	*Day Care, Group Homes, Pre-Schools*	*Other Non-Maternal*
Accident Rate	.031	.028	.031
Maternal Employment	.428	.865	.925
Child Age	1.53	1.75	1.51
Hispanic	.206	.157	.207
Black	.259	.353	.257
Mother's Age	30.2	30.6	30.1
Mother Single	.284	.289	.243
Younger Sib.	.113	.085	.072
Older Sib.	.559	.427	.479
Mother's Education	12.6	13.8	13.5
AFQT score	36.3	44.0	42.5
No. of Obs.	9,236	1,314	3,816

Notes: Means for spouse present and maternal grandfather's work status when mother aged 14 are taken over all non-missing observations.

Table 4: Descriptive Statistics for Vital Statistics Data

Variable	*Mean*	*Minimum*	*Maximum*
Vital Statistics Variables:			
Non-Auto Accidents (per 1,000 pop.)	.188	0.000	7.65
Car Passenger Accidents (per 1,000)	.046	0.000	2.67
Car-Pedestrian Accidents (per 1,000)	.027	0.000	5.03
Cancer Deaths (per 1,000)	.045	0.000	3.25
CPS Variables:			
Maternal Employment Rate	.610	.338	.857
Poverty Rate	.156	.053	.277
Urban Share	.773	0.000	1.000
Hispanic Share	.100	0.000	.574
Black Share	.144	0.000	.813
Median Income (1,000s)	24.8	14.4	43.1
Mother < HS Education	.175	.011	.397
One Parent Family	.252	.078	.622
Child Care Regulations:			
Child-to-Caregiver Ratio, Day Care	12.1	4	25
Child-to-Caregiver Ratio, Family Homes	6.03	3	16
Minimum Education Required	.848	0	1
Insurance Requirement	.378	0	1
> 1 Inspection per Year Required	.273	0	1
Distribution of Cell Sizes:			
Number of Cells	2649		
Minimum	199		
1st Percentile	1242		
Median	115,158		
Maximum	2,622,102		

Notes: Means are weighted using cell sizes. The CPS variables refer to the fraction of children living in families with the particular characteristic.

Table 5: OLS Estimates of the Effects of Child Care Regulation (NLSYCM)
(Coefficients and Standard Errors Multiplied by 10)

	All	White	Black	< HS	HS	Any College	Ages 1-3	Ages 4-5
Child Care Regulations:								
Minimum Ed. Required	-.055	-.058	-.059	.063	-.117	-.032	-.122	.017
	(.032)	(.041)	(.050)	(.070)	(.050)	(.052)	(.046)	(.041)
Insurance Required	-.011	-.013	-.014	.005	-.034	-.002	-.020	-.011
	(.019)	(.023)	(.033)	(.052)	(.029)	(.030)	(.027)	(.026)
Frequent Inspections	.015	.008	.009	.049	.014	.008	-.013	.050
	(.020)	(.028)	(.029)	(.053)	(.032)	(.032)	(.029)	(.029)
Child-to-Staff Ratio, Family Homes	.001	-.003	.006	-.006	-.001	.006	.004	-.003
	(.004)	(.005)	(.006)	(.006)	(.006)	(.006)	(.006)	(.005)
Child-to-Staff Ratio, Day Care Cntr.	-.005	-.002	-.011	-.003	-.006	-.004	-.013	-.002
	(.002)	(.003)	(.004)	(.007)	(.004)	(.004)	(.005)	(.003)
Child Characteristics:								
Male	.091	.094	.080	.088	.086	.102	.094	.085
	(.016)	(.020)	(.025)	(.045)	(.024)	(.024)	(.022)	(.022)
Hispanic	-.105	-.116		-.082	-.103	-.116	-.104	-.103
	(.025)	(.026)		(.069)	(.035)	(.040)	(.033)	(.035)
Black	-.154			-.222	-.134	-.140	-.154	-.153
	(.024)			(.065)	(.034)	(.038)	(.032)	(.032)
Younger sibling	-.056	-.042	-.068	-.153	-.011	-.054	-.072	-.039
	(.021)	(.027)	(.031)	(.048)	(.033)	(.034)	(.033)	(.028)
Older sibling	.027	.037	.010	.021	.027	.045	.017	.042
	(.021)	(.025)	(.035)	(.060)	(.031)	(.033)	(.029)	(.028)
Age 2	.084	.102	.041	.152	.117	.041	.108	
	(.028)	(.036)	(.042)	(.084)	(.041)	(.043)	(.032)	
Age 3	.080	.070	.105	.016	.117	.058	.129	
	(.031)	(.039)	(.047)	(.077)	(.046)	(.049)	(.041)	
Age 4	.034	.014	.088	.076	.083	-.029		
	(.031)	(.040)	(.049)	(.077)	(.046)	(.050)		
Age 5	.066	.035	.144	.143	.083	.017		.023
	(.037)	(.045)	(.063)	(.100)	(.052)	(.058)		(.023)
Mother Characteristics:								
Single Mother	.061	.093	.013	.068	.057	.069	.060	.066
	(.020)	(.028)	(.028)	(.054)	(.029)	(.034)	(.029)	(.027)
AFQT	.190	.215	.129	.276	.227	.183	.196	.173
	(.046)	(.054)	(.091)	(.277)	(.070)	(.063)	(.063)	(.062)
Mother Ed. HS	.004	-.030	.086				.016	-.003
	(.027)	(.036)	(.034)				(.036)	(.036)
Mother Some College	-.002	-.030	.067			.039	.015	-.014
	(.031)	(.041)	(.040)			(.030)	(.041)	(.041)
Mother Ed. ≥ 16 yrs.	-.046	-.094	.076				-.022	-.072
	(.039)	(.049)	(.063)				(.051)	(.052)
Mother Aged 20-29	.075	.069	.158	-.600	.027	.177	.024	.111
	(.105)	(.128)	(.056)	(.573)	(.180)	(.118)	(.170)	(.125)
Mother Aged 30-39	.036	.032	.134	-.583	-.015	.124	-.015	.085
	(.102)	(.124)	(.044)	(.569)	(.177)	(.112)	(.166)	(.122)
Quarter of the Year:								
Fall	.714	.773	.545	.581	.564	.895	.768	.655
	(.054)	(.065)	(.093)	(.144)	(.080)	(.083)	(.076)	(.073)
Summer	.785	.839	.635	.630	.633	.981	.819	.751
	(.055)	(.066)	(.097)	(.140)	(.081)	(.086)	(.077)	(.075)
Spring	.311	.342	.228	.266	.262	.379	.319	.302
	(.025)	(.031)	(.041)	(.063)	(.039)	(.038)	(.035)	(.036)
No. of Obs.	50384	36738	13646	6196	21460	22728	27882	22502
R^2	.022	.022	.021	.033	.018	.029	.024	.022

Notes: Standard errors in parentheses. Models also included year dummies, as well as indicators for whether the maternal grandmother and grandfather worked when the mother was 14, whether these variables were missing, and whether AFQT, maternal education, or maternal grandmother's education were missing.

Table 6: Fixed Effects Estimates of the Effects of Child Care Regulation (NLSYCM) (Coefficients and Standard Errors × 10)

	All	White	Black	< HS	HS	Any College	Ages, 1-3	Ages, 4-5
A: No Interactions:								
Minimum Ed. Require	-.208	-.264	-.160	-.085	-.236	-.220	-.294	.181
	(.077)	(.105)	(.101)	(.210)	(.120)	(.115)	(.134)	(.187)
Insurance Required	.010	-.051	.121	.420	-.132	.017	.018	-.235
	(.084)	(.103)	(.138)	(.247)	(.131)	(.124)	(.147)	(.186)
Frequent Inspections	-.145	-.142	-.154	-.071	-.049	-.238	-.377	.228
	(.072)	(.091)	(.110)	(.193)	(.113)	(.108)	(.123)	(.151)
Child-to-Staff Ratio, Family Homes	-.006	-.017	.007	-.013	.009	-.020	.008	-.044
	(.006)	(.008)	(.008)	(.016)	(.009)	(.010)	(.009)	(.014)
Child-to-Staff Ratio, Day Care Cntrs.	-.003	-.004	-.003	.007	-.0004	.007	-.019	-.018
	(.004)	(.005)	(.006)	(.010)	(.006)	(.006)	(.009)	(.009)
R^2	.020	.021	.019	.027	.017	.025	.023	.020
B: Interactions with Maternal Employment Status:								
Mother Working	.345	.613	-.242	.236	.206	.457	.514	-.180
	(.116)	(.153)	(.162)	(.310)	(.172)	(.194)	(.180)	(.277)
Minimum Ed. Required	-.052	-.013	-.154	-.023	-.136	.081	-.040	.107
	(.091)	(.126)	(.120)	(.230)	(.138)	(.149)	(.136)	(.204)
Min. Ed. Required × Working	-.277	-.426	.010	-.064	-.184	-.465	-.517	.137
	(.090)	(.119)	(.124)	(.229)	(.131)	(.149)	(.143)	(.166)
Insurance Required	-.029	-.088	.069	.431	-.176	-.019	-.046	-.275
	(.090)	(.110)	(.148)	(.256)	(.137)	(.139)	(.157)	(.194)
Insurance Required × Working	.074	.062	.071	-.061	.111	.055	.115	.067
	(.061)	(.074)	(.102)	(.160)	(.091)	(.097)	(.099)	(.117)
Frequent Inspections	-.149	-.147	-.163	-.238	-.077	-.118	-.350	.139
	(.081)	(.103)	(.121)	(.207)	(.123)	(.131)	(.136)	(.166)
Frequent Inspections × Working	.014	.022	.003	.403	.053	-.156	-.047	.168
	(.066)	(.086)	(.094)	(.171)	(.096)	(.110)	(.108)	(.125)
Child-to-Staff Ratio, Family Homes	.000	-.004	.002	-.001	.015	-.032	-.040	-.030
	(.009)	(.012)	(.011)	(.018)	(.012)	(.017)	(.151)	(.018)
Child-to-Staff Ratio, FH × Working	-.011	-.021	.010	-.047	-.013	.017	-.002	-.027
	(.010)	(.014)	(.014)	(.030)	(.015)	(.019)	(.015)	(.022)
Child-to-Staff Ratio, Day Care Cntrs.	-.001	-.000	-.006	.006	-.001	-.002	-.021	-.022
	(.005)	(.006)	(.007)	(.011)	(.008)	(.008)	(.010)	(.011)
Child-to-Staff Ratio, DC × Working	-.003	-.005	.004	.002	.000	-.006	.003	.008
	(.004)	(.006)	(.006)	(.011)	(.007)	(.007)	(.009)	(.010)
No. of Obs.	50384	36738	13646	6196	21460	22728	27882	22502
No. of Children	6828	5011	1817	936	2943	2949	5520	5632
R^2 (within)	.020	.022	.019	.028	.017	.025	.023	.020

Notes: Standard errors in parentheses. Fixed effects models also included whether or not the mother was single, younger and older siblings, child age dummies, two maternal age indicators, and season and year dummies.

Table 7: Choice of Type of Child Care from Multinomial Logit Analysis, NLSYCM Data, Children 1-3 Only, Log Odds Ratios

	All	White	Black	HS	Any College
A: Day Care Centers and Preschools					
Minimum Ed. Required	.611	.526	.752	.552	.611
	(2.69)	(2.89)	(.881)	(2.06)	(1.87)
Insurance Required	.595	.544	.664	.514	.552
	(3.77)	(3.50)	(1.80)	(2.79)	(3.20)
Frequent Inspections	.822	.895	.505	.675	.900
	(1.45)	(.630)	(2.92)	(1.74)	(.545)
Child-to-Staff Ratio, Family Homes	1.01	1.01	.103	.980	1.04
	(.529)	(198)	(.939)	(.542)	(1.49)
Child-to-Staff Ratio, Day Care Cntrs.	1.06	1.10	1.00	1.10	1.04
	(3.14)	(3.82)	(.032)	(3.19)	(1.36)
Hispanic	.966	.949		1.25	1.07
	(.079)	(2.93)		(.769)	(.270)
Black	1.57			1.42	2.96
	(3.03)			(1.13)	(5.05)
Younger Sibling	.551	.516	.644	.465	.604
	(3.35)	(3.10)	(1.37)	(2.31)	(2.18)
Older Sibling	.591	.605	.588	.482	.666
	(4.61)	(3.59)	(2.65)	(3.72)	(2.73)
Child Age 1	.016	.019	.011	.020	.011
	(14.78)	(11.30)	(8.04)	(8.52)	(9.91)
Child Age 2	.133	.013	.124	.017	.008
	(16.88)	(14.24)	(8.30)	(9.89)	(11.30)
Single Mother	1.05	1.20	.905	.978	1.31
	(.336)	(.949)	(.500)	(.101)	(1.33)
AFQT	.973	1.14	.926	3.30	4.96
	(.725)	(1.58)	(1.63)	(2.70)	(4.06)
Mother HS Ed.	2.64	2.94	2.37		
	(3.64)	(3.06)	(1.78)		
Mother Some College	4.73	3.68	6.93		1.07
	(5.41)	(3.62)	(3.74)		(.409)
Mother 16+ Yrs. Ed.	5.25	4.58	6.79		
	(5.48)	(3.99)	(3.50)		
Teen mother	.795	1.35			1.34
	(.353)	(.477)			(.466)

Table 7: (Continued)

	All	White	Black	HS	Any College
B: Other Child Care					
Minimum Ed. Required	1.12	1.10	1.34	1.31	1.02
	(.869)	(.624)	(1.17)	(1.32)	(.101)
Insurance Required	.906	1.02	.613	1.04	.800
	(1.21)	(.244)	(2.58)	(.282)	(1.94)
Frequent Inspections	1.04	1.19	.691	.919	1.17
	(.467)	(1.66)	(2.89)	(.633)	(1.27)
Child-to-Staff Ratio, Family Homes	.975	.998	.928	.966	.975
	(1.63)	(1.24)	(1.93)	(1.46)	(1.09)
Child-to-Staff Ratio, Day Care Cntrs.	1.05	1.05	1.03	1.11	.992
	(3.12)	(3.07)	(1.00)	(4.39)	(.373)
Hispanic	1.14	1.11		1.48	1.17
	(1.21)	(.941)		(2.37)	(.985)
Black	1.13			1.37	1.52
	(1.23)			(1.84)	(2.66)
Younger Sibling	.565	.566	.597	.598	.568
	(5.19)	(4.39)	(2.44)	(2.79)	(3.82)
Older Sibling	.682	.665	.772	.610	.721
	(5.44)	(5.02)	(1.74)	(4.48)	(3.32)
Child Age 1	.924	.100	.090	.166	.046
	(9.27)	(7.89)	(4.31)	(4.71)	(7.20)
Child Age 2	.683	.069	.074	.122	.036
	(11.04)	(9.76)	(4.88)	(5.96)	(8.11)
Single Mother	.946	1.10	.780	.907	1.08
	(.614)	(.826)	(1.62)	(.739)	(.568)
AFQT	1.04	1.04	1.04	3.17	2.04
	(1.26)	(1.14)	(.852)	(3.73)	(2.64)
Mother HS Ed.	2.20	1.90	3.24		
	(5.23)	(3.78)	(3.51)		
Mother Some College	3.41	2.83	5.73		.964
	(7.76)	(5.80)	(5.04)		(.308)
Mother 16+ Yrs. Ed.	3.71	2.97	6.79		
	(7.66)	(5.67)	(5.04)		
Teen Mother	.179	.205			.095
	(2.76)	(2.48)			(2.20)
Pseudo R^2	.084	.082	.125	.075	.085
No. of Observations	14,366	10,526	3,840	5,982	6,774

Notes: The models also include dummy variables for male children, for whether the maternal grandfather/grandmother worked when the mother was aged 14 and whether these variables were missing, quarter dummies, and an annual time trend.

Z-statistics in parentheses.

Table 8: Child Care Regulation and Deaths
(Coefficients and Standard Errors × 10)

	Cause of Death:			
	Non-Car Accident	**Car Passenger Accident**	**Car Pedestrian Accident**	**Cancer**
Young × Min Ed. Required	-.132	.025	.054	-.005
	(.059)	(.020)	(.015)	(.021)
Minimum Ed. Required	.072	-.032	-.052	-.001
	(.059)	(.021)	(.015)	(.002)
Young × Insure Required	.079	-.024	-.007	.001
	(.043)	(.015)	(.031)	(.015)
Insurance Required	-.177	.012	.013	-.003
	(.121)	(.042)	(.31)	(.004)
Young × Frequent Inspections	.193	.010	-.003	.002
	(.045)	(.016)	(.011)	(.016)
Frequent Inspections	-.203	-.012	.024	-.055
	(.081)	(.042)	(.020)	(.029)
Child-to-Staff Ratio, Family Homes	-.000	-.009	.001	-.000
	(.010)	(.004)	(.003)	(.005)
Young × Child-to-Staff Ratio, FH	.021	.008	.002	-.000
	(.014)	(.005)	(.004)	(.005)
Child-to-Staff Ratio, Day Care Cntrs.	-.030	-.002	-.001	.000
	(.005)	(.002)	(.001)	(.003)
Young × Child-to-Staff Ratio, DC	.032	.009	.004	.000
	(.008)	(.003)	(.002)	(.003)
Young (Aged 1 to 4)	.625	-.127	-.145	.043
	(.126)	(.044)	(.032)	(.046)
Child Black	1.27	.048	.182	-.012
	(.026)	(.009)	(.007)	(.010)
CPS Variables:				
Working mothers	.398	.070	.092	.257
	(.329)	(.176)	(.083)	(.185)
Hispanic	-.562	-.165	-.195	-.012
	(.517)	(.179)	(.130)	(.188)
Black	.013	.250	.122	-.252
	(.509)	(.176)	(.128)	(.185)
Median Income (1000s)	.003	-.000	.005	.000
	(.010)	(.003)	(.003)	(.004)
Mothers with HS	.280	-.199	.079	-.154
	(.412)	(.143)	(.104)	(.150)
One Parent Families	.034	.027	.141	.109
	(.452)	(.157)	(.114)	(.164)
Poverty	.131	-.637	.069	.004
	(.875)	(.304)	(.220)	(.318)
R^2	.744	.462	.413	.237

Notes: Standard errors in parentheses. The models also included state and year dummies. There were 2649 cells. All estimates weighted by cell size.