Accidents Will Happen?
Unintentional Childhood Injuries and the Effects of Child Care Regulations

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November 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, the University of Toronto, the NBER Summer Institute, the University of Texas at Austin, Stanford University, the University of Chicago, and the Child Care to Welfare Conference 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 day care center directors to have more education reduces the incidence of unintentional injuries. An auxiliary analysis of the choice of child care mode confirms that these regulations are binding and that higher educational requirements tend to crowd some children out of care, as do regulations requiring frequent inspections of child care facilities and lower pupil-teacher ratios. 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.

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1. Introduction

Over the last half of the twentieth century, accidents have emerged as the leading cause of death among American children over one year of age. 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. Among very young children (1 to 3 year olds), unintentional injuries accounted for 1,798 deaths in 1996 compared to 636 deaths due to congenital problems, the next leading cause of death. The incidence of deaths due to accidents relative to other causes is even greater for older children. Moreover, deaths represent only the tip of the accidents "iceberg." It is estimated that between 1987 and 1995, while 6,600 American children died annually from preventable injuries, 246,000 children per year were hospitalized due to injuries, and injuries resulted in almost 9 million emergency room visits and 12 million physician visits each year (National SAFE KIDS Campaign, 1998).

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 contrasts with a view that accidents are the result of choices made by parents, family, supervising adults and society about the extent to which children are exposed to risk 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. Tabulations from the 1995 Survey of Income and Program Participation suggest that 42% of children between 1 and 3 years old are in some form of organized care, and that almost a third of these children are in formal center based care rather than more informal family homes (U.S. Census Bureau, 1997). The fraction of children in child care is even higher among 4 and 5 year olds. Thus, there appears to be considerable scope for reducing childhood injury rates by improving the safety of child care settings by their regulation.

In this paper, we examine the relationship between accidental injuries among young American children and child care regulation. As with other consumer products and services, government imposes regulation on child care providers with the goal of reducing the risk of harm to children. Potential risks include harm from injury as well as from disease and developmental impairment (Morgan and Azer, 1997). Regulations stipulate such things as the educational requirements for child care providers, the maximum number of children per child care staff mem-

[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.

ber and the frequency with which facilities are inspected. Most of these regulations are set at the state level and vary across states in the U.S. as well as within states over time. We exploit this variation in order to assess the impact of regulation 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. Data on other characteristics of states are constructed from the March Current Population Surveys (CPS) and merged to the VSDM.

We find that regulations requiring directors of child care centers to have more education significantly reduce the risk of both fatal and non-fatal injury. However, these regulations are not without their costs. Evidence from an auxiliary analysis of the choice of child care mode confirms that child care regulations are binding and suggests that the imposition of stiffer educational requirements crowds some children out of regulated care by making this care more expensive. Requiring inspections of child care facilities and lowering pupil-teacher ratios 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 regulation outweigh their direct 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 6 and Section 7 concludes.

2. Background Regarding Injury Risks and Child Care

Over the last 30 years, there has been a substantial decline in the incidence of deaths to children due to unintentional injuries in the U.S.[2] From 1979-98, death rates due to accidents declined by 52.1%, 51.3% and 45.1% among children ages 1-4, 5-9 and 10-14, respectively, 31.0, 17.5, and 11.9 per 100,000 children for these same age groups (National Center for Health Statistics, 2001). These declines in accidental deaths to children exceeded the reductions in death rates to children from all causes (46.1%, 43.1%, and 30.5%, respectively) and rivaled or exceeded declines in death rates due to congenital anomalies (54.4%, 41.2%, and 43.8%, respectively) and malignant neoplasms (cancer) (declines of 47.8%, 48.9% and 34.1%, respectively). Furthermore, we note that childhood accidental deaths rates declined for all racial and ethnic groups (National Center for Health Statistics, 2001).

At the same time, important and persistent differences exist in rates of accidental deaths, and the incidence of injuries, to children in the U.S. by race, ethnicity, socioeconomic status, and residential location. For example, while childhood rates of accidental deaths have declined for all

[2] A similar trend has occurred in other developed countries (UNICEF, 2001).

racial and ethnic groups, they have declined more rapidly among white relative to African-American children (National Center for Health Statistics, 2001). Accidental death rates among white children declined by 51.9%, 53.5%, and 46.9% compared to 47.9%, 46.7% and 35.1%, respectively, for African-American children for the age groupings noted above (National Center for Health Statistics, 2001). As of 1998, childhood accidental death rates for African-American children remained 1.7 times higher than those for white children (National SAFE KIDS Campaign, 1998).

Disparities in accidental deaths also exist by poverty status, with children from low-income households being twice as likely to die in a motor vehicle accident, four times more likely to drown and five times more likely to die in a fire than non-poor children (National SAFE KIDS Campaign, 1998). We note that these disparities in accidental death rates to children, aged 1-14, exist, even though there are relatively small and narrowing differences by race, ethnicity and income in death rates due to congenital anomalies and cancer (NCHS, 2001).[3] Finally, childhood accidental deaths rates and injuries rates vary by where children live. Children living in rural areas have higher rates of death due to accidents than those in urban and suburban areas while children in inner-city areas appears to be at greater risk of sustaining severe, but non-fatal injuries than their rural and suburban counterparts (National SAFE KIDS Campaign, 1998).

An important question is the extent to which the quality of child supervision plays a role in 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), who are thought to receive less supervision than children of two-parent households and those with older mothers.

With respect to the relationship between non-parental child care and injury risk, the evidence suggests two things. First, licensed, regulated, day care centers are 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 centers, compared to 35 per 100 children in the community at large. Other researchers have found similarly low rates of injuries in day care (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 and World Report, 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. Consumer Product Safety Commission, 1999).

These findings suggest that there may be scope for reducing injury rates in licensed child-care settings through stricter regulation. However, the majority of children are cared for in un-

[3] We also note that death rates to children from causes such as burns, drownings, and falls are systematically lower in Europe than they are in the United States, even though there are virtually no differences in death rates from congenital anomalies or malignancies across most developed industrial countries (Williams and Miller, 1992).

regulated 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

At issue is whether child care regulations have any effect on the safety of children. In principle, imposing more stringent minimum standards on child care arrangements should reduce the incidence of accidents and deaths due to unintentional injuries to children. But this conclusion presumes that: (1) these standards are binding on the existing practices in child care settings; (2) these regulations are enforced; (3) parents do not "avoid" these regulations by the child care arrangements they choose. The validity of each of these conditions is potentially at issue and their failure to hold may account for why tightening regulations on the provision of non-parental child care services may not have the "intended" consequences with respect to the safety of young children. In this section, we focus on the role that parental choice plays in how child care regulations may affect child safety.

Consider the following model of child care choice.[4] Parents are assumed to maximize the 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 of time. In this setting, child quality is produced by the production function,

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

in which goods and services and and non-working time (leisure) are combined with random factors, v, produce child quality. Child quality includes the safety of children or, alternatively, the risk of injury to children.

In this simple setup, non-parental child care arrangements are X inputs in the production of child quality that are purchased by parents. Suppose there are two types of child care, X_r, which is regulated and subject to minimum standards, and X_u, which is unregulated.[5] Let these inputs have unit prices of p_r and p_u, respectively. For now, we assume that parents have complete information about the inputs they purchase and, thus, the quality of care these inputs produce, including the risk of injury to their children.

To the extent that higher quality, and safer, child care arrangements are costly to produce,

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

[5] Note that care provided by parents constitutes a form of unregulated child care.

binding child care regulations are likely to increase p_r relative to p_u. Thus, while parents may prefer safer child care arrangements, all else equal, imposing more stringent regulations will tend to "price," or "crowd," some parents—namely, those with a lower willingness to pay for higher quality care—"out" of regulated care. As a result of this "crowd-out" effect, it is unclear whether imposing more stringent standards on regulated child care will necessarily increase the quality of care, including safety, to which children are exposed.

There is evidence that suggests this crowd-out effect of regulations may be present in child care markets. Chipty and Witte (1997), using data from a national sample of child care centers, find that lower required child/staff ratios for preschool children reduce the probability that child care centers care for preschool children rather than school age children, and vice-versa. Blau (2001) considers a more comprehensive set of child care regulations and finds using data from the Survey of Income and Program Participation that child care regulation affects the type of child care that is chosen (though he finds no impact on child care expenditures or hours in care). Below, we provide some additional evidence on this effect on parental choice using data from the NLSY.

Until now, we have assumed that parents have complete information about how different inputs affect the production of child quality. But, this may not be the case. 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.

Informational deficiencies among consumers with respect to the quality is a common concern in markets for many goods and services and its potential for generating adverse selection in the markets for such services is well-known.[6] Imposing minimum quality standards, via regulation, represents one mechanism for solving such informational problems faced by consumers. 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.[7]

In the context of the child care market, imposing minimum quality and safety standards on day care centers may solve parent's lack of information about the quality of particular child care settings, at least to the extent that these standards are enforced. For example, regulations may change the production function for child quality, making it easier to avoid unintentional injury with a given level of parental effort. 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 for it. With respect to this "quality assurance" effect of regulations, Chipty and Witte (1995), using individual-level data from the National Child Care Survey, find that increasing the number of mandatory inspections increases both the price of child care and the number of hours that chil-

[6] See the seminal paper by Akerlof (1970) and the recent survey of the literature on asymmetric information by Riley (2001).

[7] 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), Chipty and Witte (1995) and Hotz and Kilburn (1997, 2000) for more on the application of such arguments to the market for child care services.

dren spend in care. This finding is consistent with the idea that minimum quality standards may encourage consumers to purchase more child care.

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 of regulations on child safety is ambiguous, with the potential crowd out effect balanced against the quality assurance effect. Estimating the magnitudes of these separate effects is difficult, requiring the imposition of more structure on the parental child care choice process and child quality production functions in order to separately identify these effects.[8] In the empirical analysis that follows, we attempt to isolate the net, or reduced form, effects of regulations on child care choice and accidents as a measure of child quality.

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 injuries, rather than just the small fraction of injuries resulting in death. This is one of the very few national surveys of non-fatal injuries among children that exists, and 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. In addition to analyzing the effects of child care regulations on accidental deaths, we also estimate their effects on other causes of death to children. We consider the latter estimates in order to assess our ability to isolate the effects of regulations on child care settings, since one would not expect such regulations to deaths due to cancer, for example. 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. 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

Most states have two types of child care regulations, those that apply to day care centers, and those that apply to less formal child care setting referred to as "family homes." We look at

[8] Hotz and Kilburn (1997) attempt to do this in their model of child care mode choice and maternal labor force participation.

regulations in both settings. The regulations we focus on include ratios of children to care givers; the number of mandatory inspections of child care facilities per year; and the education required of child care center directors or of providers in family homes. As Blau (2001) emphasizes, there are literally dozens of different child care regulations, many of which tend to be highly correlated with each other. For example, education requirements for child care center directors are correlated with education requirements for teachers and aides, as well as requirements specifying minimum experience levels and ages. Requirements on child-staff ratios tend to be highly correlated with maximum group sizes. Rather than attempting to identify the effects of all of the individual regulations, we have chosen to focus on selected measures which are representative of different regulatory approaches, and which have been examined frequently in other studies. One potentially important type of regulation that we do not consider in this study is whether states require child care providers to carry liability insurance. Over our sample period, only Alaska and Louisiana changed insurance regulations for day care centers and only Arizona and Wisconsin changed them for family homes.

Table 2 provides a summary of the national trends in the child care regulations we examine in this study over the period 1987-1998. The means, taken over the fifty states plus the District of Columbia, shown in Table 2 suggest that at the national level, there was relatively little change in the mean number of inspections required in day care centers and family homes. These averages mask many changes within individual states, however. Twenty-two states changed the number of inspections required in family homes, and 14 states changed the number of inspections required in day care centers over our sample period. Some states increased inspections while others decreased them. For example, Illinois changed the required number of annual inspections of family homes from 1 to .5 between 1993 and 1994, and then increased the number back to 1 in 1997. Alabama decreased the number of inspections of day care centers from 2 to 1 between 1987 and 1988, while Pennsylvania went from having no inspections of day care centers to having annual inspections between 1991 and 1992.

Changes in minimum education requirements are more evident in Table 2. Over our sample period, the average state began requiring high school diplomas from day care center directors. However, once again, the average masks considerable heterogeneity. For example, 7 states went from having no requirements on the education of day care center directors to requiring more than a high school degree (usually 13 or 14 years of education) and Nevada, South Carolina and Utah moved to increase their requirements for center directors from 12 years to 14. But not all states followed this general trend. Over this same period, 9 states that had required some college actually reduced their requirements for center directors to having only a high school diploma. With respect to the imposition of education requirements for family home providers, the statistics in Table 2 indicate that this is comparatively uncommon, although we do note that 10 states began imposing some sort of minimum education requirements (usually high school) on this type of child care providers over our sample period.

Finally, Table 2 suggests that there was not much change in average maximum child-staff ratios over our sample period, but again, there is more variation within states than these averages would suggest. For example, if we look at regulations for 3 year olds, we see that 10 states increased child-staff ratios in family homes, while 7 states decreased them. In day care centers, 3 states increased maximum child-staff ratios covering 3 year olds, while 4 states decreased them.

In summary, there is a good deal of within-state variation in the measures we are examining. While many states were tightening regulations, some states relaxed them over our sample period. In the analysis below, we attempt to exploit this within-state temporal variability to iden-

tify the effects of these regulations on accident rates and death rates due to 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.[9] 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 practice though, there are very few reports of accidents before 1987, so we limit our sample period to 1987 through 1998.

In total, we have accident data for 6,702 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 congenital anomalies. 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 7.3 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. After excluding children with missing information, we have a total of 49,255 quarters of child life data.[10] The NLSYCM surveys also included questions about child care in the 1986 and

[9] 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.

[10] We include dummy variables for such things as missing maternal education in order to minimize the number of observations excluded for missing data. We lose some observations from the beginning of our sample period be-

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 3 and over, we restrict this part of our analysis to children 1 and 2 years old. Our "child care" sample covers 13,654 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 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, maternal education category, and child age. 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. These accident rates seem too low, given the epidemiological evidence cited above. For example, if 35% of children have medically attended injuries in any given year, then approximately 9% of children should have such injuries in each quarter. Moreover, if black children are 1.7 times more likely to die from accidents than white children, one might expect to see substantially higher rather than lower rates of medically attended injuries among black children. Patterns of accident rates by maternal education also suggest that there are systematic biases in the reporting of medically attended injuries since reported accident rates increase slightly with the education of the mother even though you would expect actual injury rates to fall.

In summary, 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. These differences in reporting provide important rationales both for allowing the estimated effects of regulation to differ by race and education, and for including child fixed effects in our models as a means of controlling for maternal propensities to report accidents.

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 reported type of child care, for those mothers and children for whom we have child care information. 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.[11] 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

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cause of missing regulation data. For example, there are 798 quarterly child observations missing data on education requirements for day care directors.

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

second category are affected by the regulation of family homes, though some children in this category must be.

There are several noteworthy patterns in the accident rates by mode of child care in Panel B of Table 3. First, the overall use of child care seems to be under-reported relative to what national surveys of child care use suggest. Recall that the Census bureau reported that about a third of 1 to 3 year old children were in child care centers in 1995. 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, have siblings care for younger children, or perhaps do not report father care as "child care."[12] However, there is likely to be 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. Fortunately, the rates of maternal employment are much higher for mothers who do report using child care, suggesting that there is some signal here. Third, accident rates do appear to be slightly lower among children in the most regulated child care settings and in the no-care category compared to in less regulated child care settings.

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 both the 1987-1998 sample period (for comparability with our NLSYCM data) and for 1983-1998 since this is the full period for which we have data about child care regulation. 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. [13]

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 below, since we expect children in this age range to be much less affected by child care regulation than younger children. Census bureau figures from the 1995 SIPP suggest that only 8% of children 5 to 13 were in any kind of organized child care facility, including family homes (Smith, 2000).

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 1,284 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 and

[12] 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.

[13] In a previous version of this paper, we constructed rates for each single year of age by combining information from the Detailed 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.

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, some 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 a maximum of 2,497 cells over the period 1983-1998.

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 (though it is not impossible that such deaths could occur while children are in care). 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 .169 per 1,000, which breaks down to .033 deaths per 1,000 to car passengers, .018 deaths per 1,000 attributable to pedestrians/car accidents, and .118 deaths per 1,000 due to all other unintentional causes. Cancer deaths are similar in importance to car passenger deaths with a rate of .037 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 6% 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 is 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 vital 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

In analyzing the effects of child care regulations on accidents to children, how one identifies the causal effects of regulations is an important and potentially contentious issue. Regula-

tions may be the result of political processes and considerations that reflect, in part, the attitudes of parents and/or the influence of child care providers. As such, the regulations that states set may be correlated with parental child care choices and outcomes such as accident rates.[14] Blau (2001) highlights this issue in a recent study of the effects of child care regulations on parental child care choices and the supply of child care workers. He stresses that although many previous studies of the effects of child care regulations on choice of child care mode and other outcomes have relied on cross-state variation in regulations, stable coefficient estimates are obtained only when state and year effects are included in the estimating equations.

In an attempt to address these potential threats to isolating the impact of regulation on childhood accidents, we employ several alternative strategies in our empirical analyses. In particular, we control for differences across states (and their populations) by controlling for state fixed effects in most of our analyses. In our analyses of accident rates using the NLSY data, we also employ child-specific fixed effects to control for differences across parents that may be correlated with their state of residence and thus with regulations, and also to control for potential reporting biases. To our knowledge, our work represents the most extensive effort to date to account for the potential endogeneity of regulation in models of child outcomes.

a) Estimation Using Individual-Level Data

There are a number of reasons to be concerned about the potential for endogeneity of state-level regulations with respect to both the modes of child care that parents choose and the incidence of accidents to their children. 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 regulations 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, for example.

These potential problems directly impinge on our ability to isolate the effects of child care regulations on child care choices and accidents in our econometric analyses. The individual-level, longitudinal data available in the NLSY allows us to exploit several strategies to mitigate these problems. First, we include state-specific fixed effects in our analyses of accidents among children of NLSY mothers. This allows us to sweep out permanent differences between states and their populations that account for the endogeneity of regulations on child outcomes. Second, the longitudinal feature of the NLSY data allows us to also control for child-specific fixed effects to sweep out differences across families that may be correlated with their place of residence or with their propensities to report accidents.

[14] See Besley and Case (2000) for a discussion of the endogeneity of regulations and the consequences for estimating their impacts on behavioral choices.

We use both of these econometric strategies in the analysis of the effects of regulations on childhood accidents presented below. Data limitations, both in terms of the quality of information and the number of years for which we have information on child care arrangements of children—we only have reliable data for children of ages 1 and 2—limit our ability to implement these strategies in our analysis of the effects of regulations on child care mode choices. For the latter analyses, we limit our specifications to controlling for fixed effects for geographical regions of the country (e.g., New England, Mountain and Pacific states) and do not include child-specific fixed effects.[15] Thus, we consider our estimates of the effects of regulations on child care mode choices to be more susceptible to the endogeneity biases noted above than is the case for our estimates of regulation effects on childhood accidents. On the other hand, we are able to exploit the fact that regulation of day care centers should have its most direct impact on the use of centers, while regulation of family homes should have a greater impact on the use of more informal types of care.

More precisely, for our analyses of accidents, we estimate models of the following form:

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

where ACCIDENT is a dummy variable equal to 1 if child *i* was reported to have 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; STATE is a vector of state dummy variables that is equal to 1 for the state in which the child resides in year *t* and 0 otherwise; and YEAR is a vector of year dummies. Also note that we allow α to vary across children, i.e., the vector of α_i's represent child-specific fixed effects.

We also estimate variants of this specification that allow for different effects of regulations across various subgroups in our data by interacting the CCREG vector with indicator variables for these subgroups. In particular, we examine how the effects of regulations vary by race, the education of the mother, and the mother's work status. Examining differences in the impacts of regulations across these groups provides an important check on the plausibility of our findings. For example, one might expect 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.

To estimate the effects of regulations on the child care modes chosen by parents for their children, we make use of multinomial logit methods. In particular, we employ the universal logit specification in which we specify the following index functions for the "formal" and "informal" modes of child care:

$$I_{it}^m = \beta_{m0} + \beta_{m1}' \text{CCREG}_{it} + \beta_{m2}' X_{it} + \beta_{m3}' \text{SEASON}_t + \beta_{m4}' \text{REGION}_t + \beta_{m5}' \text{YEAR}_t + \varepsilon_{it}^m, \qquad (5)$$

[15] An important issue when using estimators that control for both child and state fixed effects is the extent to which children actually face differing regulations due to either changes in a particular state's regulations over time and/or the change in the state of residence for certain children. In fact, large numbers of children in our data do experience changes in regulations. For example, 320 children experienced a change in educational requirements for day care center directors or family home providers over the time that we observe them. Of these, 134 children experienced a change in regulation because they changed states.

where m denotes the mode choice (m = 1 for day care center or nursery school, = 2 for other modes of non-parental care, and = 3 for parental care) and ε_{it}^{m} is a mean-zero, extreme value random error that is independently distributed across modes. It follows that the observed mode choice satisfies the following condition:

$$\text{Observe } m \text{ if and only if } I_{it}^{m} = \max_{j \in 1,2,3} \{I_{it}^{j}\}. \tag{6}$$

As is standard in the identification of multinomial logit models, we normalize all of the coefficients for one of the mode choices—m = 3 in our case—to zero. Below, we do not present the estimates of the β_m's but rather we present estimates of the marginal effects of the covariates included in the specifications of the index functions in (5) on the probability of choosing a particular mode. This estimate captures the direct and indirect effects of a particular covariate on the likelihood of choosing a particular mode. (Estimates of the standard errors for these marginal effects are also presented below.) As with our analysis of accidents, we examine how the effects of regulations vary across subgroups by also interacting the regulation variables in (5) with subgroup indicators.

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:

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

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 to 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 is less directly affected by these regulations. If there are unmeasured characteristics of states and years that are associated with the passage of child care regulation, then these will be reflected in δ_3, the vector of coefficients that 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) Regulation and the Choice of Child Care Mode

Table 5 presents results on the effects of state regulations on the parents' choice of child care arrangements. Panel A presents estimates of the marginal effect of a change in these regulations, and those of other variables, on the probability of choosing day care centers and pre-

schools and of less formal modes of child care, while Panel B summarizes how the estimated effects of the regulation vary by race and mother's educational attainment. The estimates in both Panels of Table 5 provide evidence that the child care regulations we examine are binding and affect the child care choices made by parents. These estimates also shed light on the potential crowd out effects of regulations, and on spillovers between regulation of child care centers and family homes. The estimates show that increasing the number of annual inspections of day care centers has a large negative effect on the probability that this form of care is chosen. Increasing the education requirements for day care center directors also has a statistically significant negative effect on the probability that centers are chosen, though the effect is smaller. Increasing the requirements for center directors also increases the probability that other forms of non-maternal care are chosen. Other forms of regulation have no significant effects in the model for all children.

Panel B of Table 5 shows that there are some interesting differences in the effects of regulation by race and maternal education. More stringent regulations regarding the inspection and education requirements in day care centers have significant impacts on white women, and on more educated women (rather than high school dropouts). Increasing the child-staff ratio in day care centers also appears to encourage white women to use centers. Increasing the education requirements for providers in family homes encourages black women to substitute out of other forms of care and into child care centers.

Turning to less formal care, the bottom half of Panel B of this table shows that increasing the frequency of inspection in family homes has a strong positive effect on the usage of such care by college educated women. Minimum education requirements for day care center directors encourage the use of other forms of care among women with high school educations, while minimum education requirements for family home providers discourage the use of other modes of non-parental care among black women. Finally, higher maximum child-staff ratios in day care centers encourage women to use other sources of non-maternal care, while higher maximum child-staff ratios in family homes have the opposite effect. These latter results suggest that women who are likely use other forms of non-maternal care (besides day care centers) do not like large child-staff ratios.

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, while small sample sizes preclude the use of state or child fixed effects, these estimates appear to be very reasonable in that more stringent regulation of day care centers reduces the use of centers and encourages the use of other forms of non-maternal care, while more stringent regulation of family homes tends to encourage the use of day care centers, or no care. These estimates suggest that child care regulation does bind, at least in terms of choice of child care mode, and that stricter regulation is associated with children being squeezed out of regulated care.

b) Results for Accidents Requiring Medical Attention

Tables 6 and 7 present results for the effects of regulations on the likelihood that a child experiences an accident requiring medical attention in a given quarter. The regression specifica-

tions used to produce the estimates in Table 6 included state and time fixed effects, while those in Table 7 included fixed effects for each child in the sample. Each table includes two panels: Panel A displays estimates for the entire sample and Panel B displays estimates of the effects of regulations for different demographic groups. Consider first the results in Panel A of Table 6. There we find that minimum education requirements for day care center directors have a significant negative effect on accident rates. Comparing the coefficient estimate of -.0012 to the means in Table 3 suggests that increasing the education requirement by 2 years would reduce accident rates by 8%. None of the estimates for the other regulation variables are statistically different from zero.

Most of the coefficient estimates for the other variables displayed in Panel A of Table 6 follow the patterns one might expect on the basis of the epidemiological literature. These results are of interest given that the epidemiological literature seldom looks at the effects of covariates in a multivariate context. We find that, other things being equal, 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, being significantly greater for toddlers than for older or younger children. 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 in 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. And we find no statistically significant effect of maternal education, even though we expect true accident rates to be lower for more educated mothers.

Panel B of Table 6 shows how the estimated effects of regulations on the probability of an accident vary with race, maternal education, age of child and maternal employment. These estimates suggest that the effects of minimum education requirements for day care center directors are similar for both black and white mothers, but that they are greater for women with at least high school educations. These regulations also have a greater effect on children of working mothers than on children of non-working mothers, as one would expect since the former are more likely to be in care. Higher maximum child-staff ratios are also estimated to have negative effects on accident rates among whites, and among children of high school dropouts. It is possible that looser regulation in this regard reduces accident rates by drawing children into regulated care. Finally, higher education requirements in family homes are estimated to increase accident rates among children of high school dropouts, perhaps by squeezing them out of the regulated sector.

As noted above, child-specific fixed effects offer a powerful way to control for the possible maternal differences in the propensity to report accidents. Coefficient estimates for specifications that control for child-specific fixed effects are displayed in the two Panels of Table 7. The results in Panel A of this table are qualitatively similar to those found in Table 6, though the estimated effect of minimum education requirements for day care center directors is larger than those found in the former table. Comparing this coefficient to the mean accident rate in Table 3 implies that increasing educational requirements by two years would reduce accident rates by 13%. However, since in principle, the child-fixed effects estimates are purged of much maternal reporting bias, it may be more appropriate to compare the estimated coefficient with a baseline from the epidemiological literature. As discussed above, the literature suggests that approxi-

mately 9% of children have an injury requiring medical attention in each quarter, which suggests that increasing minimum education requirements on center directors by 2 years would reduce injury rates by 4%.

Panel B of Table 7 displays the estimates we obtain when we allow effects to vary with race, education, and maternal employment status. The main qualitative difference between these estimates and those obtained using state fixed effects, is that we now find that the effects of minimum education requirements for day care directors are concentrated among whites, and are not statistically significant for blacks. This set of results suggests that black under-reporting of accident rates is greater in states with stricter regulation, generating a spurious negative correlation between strict regulation and low accident rates in models that do not control adequately for the maternal propensity to report accidents.

We also find that lower child-staff ratios in family homes, which were associated with higher accident rates for children of high school dropouts in Panel B of Table 6, are associated with higher accident rates only among children of college educated mothers once child fixed effects are included in the model.

Where they are statistically significant, the point estimates in Panel B of Table 7 are also larger in absolute value than those in the corresponding panel of Table 6. For example, they suggest that among whites, increasing the education required of day care center directors by 2 years would reduce accident rates by between 7% and 18%, depending on whether we take a 9% or a 3.3% accident rate as our base.

In summary, the results so far paint a remarkably consistent picture of the effects of minimum education requirements for day care center directors. These regulations reduce accident rates. Effects are concentrated among whites, and among children of mothers with at least a college education. 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, these minimum 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 crowd children out of day care centers, but do not have any significant effect on accident rates. Regulation of child-staff ratios has more complex effects. Lower ratios in day care centers crowd children out of centers and into less regulated care, while lower ratios in family homes encourage families to use other forms of non-maternal care. However, lower ratios in family homes are also associated with higher accident rates.

c) Results Using Vital Statistics Data

Models based on specification (7) were estimated using the aggregate Vital Statistics data and 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 regulations to have larger effects on 1 to 4 year olds than on 5 to 9 year olds, since older children are much less likely to be in care. Thus, our main focus is on the interaction between "YOUNG" and the child care regulations. If it were the case that child care regulation had no effect on 5 to 9 year olds, then we could interpret any statistically significant coefficients on the "main effects" of regulation as evidence that regulatory policies were more

likely to be adopted in states with higher/lower rates of accidental mortality than in others. However, concerns about policy endogeneity should be less acute for minimum education requirements as these are less likely to be enacted in response to accidents in child care then regulations governing inspections and ratios–instead, minimum education requirements are likely to reflect a desire to provide more developmentally appropriate care.

Estimates for the 1987-1998 sample are shown in Panel A of Table 8. The coefficient on the interaction between YOUNG and minimum education requirements is negative and statistically significant for non-car accidents, but is not significant for accidents to car passengers, accidents involving cars and pedestrians, or for cancer deaths, and the main effects are not statistically significant. These estimates indicate that increasing the minimum education required of day care center directors by two years would reduce deaths by 1.8 per 100,000. 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 4%.

We also present estimates of the same specification for the 1983-1988 period in Panel B of Table 8. The estimated effect of minimum education requirements for day care center directors is somewhat larger in this longer time period and implies that an increase in these requirements by two years would reduce child-care related deaths by 6%. The main effect of this variable is however, significant and negative in the model for accidental deaths involving cars and pedestrians which suggests that these requirements are more likely to be adopted in states and years where contact between children and cars is more likely (e.g. in states that are becoming more urban over time).

Higher child-staff ratios in day care centers are estimated to increase non-car accident rates among young children, though the main effect of this variable is negative. Thus, although higher ratios increase accidents, they are more likely to be permitted in states and years with low accident rates. A higher number of inspections in family homes is associated with higher non-car accident rates among young children, though again, the main effect suggests that the number of inspections is likely to be higher in areas that have low overall accident rates.

Finally, it is interesting to note that in both sub-samples, higher educational requirements for family home providers are associated with increases in car-pedestrian accident rates among young children. It is possible that this increase reflects children being crowded into less regulated child care settings.

The control variables constructed using the CPS are generally not statistically significant. This result indicates that it is difficult to control for time-varying state characteristics that may be correlated with accident rates using aggregated 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 older children, and comparing results for different types of accidents to those for cancer deaths.

7. Discussion and Conclusions

We find consistent evidence that requiring day care center directors to have more education reduces accident rates. In the NLSYCM, we find that accidents requiring medical attention are reduced for all children, though effects are stronger among white children and among children of 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 higher minimum educational requirements for day care center directors also reduce accidental deaths.

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. We will concentrate on 2 year increments in minimum education requirements for day care center directors in this discussion, since much of the policy debate in recent years has been focused on whether these workers should be required to have 12, 13, or 14 years of education. Our estimates imply that in a group of 100,000 children, increasing this education requirement by 2 years would reduce the number of accidents by 380 per quarter, or 1,520 per year and would also reduce the number of deaths per year by 1.8-2.4.

If the average day care center had 40 children, then it would take 2,500 directors to look after these children. If it was necessary to raise the wages of all of these directors by $2.61 and they worked 2,000 hours per year, then implementing the minimum education policy would cost $13 million per 100,000 children. This estimate implies that the cost per life saved through education requirements is between $5.4 and $7.2 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). However, this is likely to be a high estimate of costs, given that there will be some directors who already meet the new educational requirements.

But minimum education requirements also bring other benefits. The private and public costs associated with childhood accidents for surviving children are substantial. In 1998, the total annual costs of unintentional injuries to children under the age of 15 were estimated to be $157 billion, of which $5 billion were medical costs, $3.3 billion were for earnings lost, and $148 billion were for lost quality of life (National SAFE KIDS Campaign, 1998). On a per-injured-child basis, this amounts to annual average costs of $650 for medical care, $1,000 in lost future earnings and $11,000 in lost quality of life. Among children between the ages of 5 and 14, the costs of treating accidents exceed those associated with the treatment of any other condition (National SAFE KIDS Campaign, 1998). Even if we take the very conservative approach of discounting reduced quality of life, reductions in the costs of medical care and foregone wages would offset $2.5 million of the $13 million increase in wage costs per 100,000 children.

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.

Our results indicate that 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 such as direct inspections that are aimed at improving child safety crowd children out of regulated care without appearing to have much effect on accident rates. On the other hand, requiring day care center directors to have more education has positive overall effects on child safety, even though these regulations cause some children to be crowded out of regulated care. These requirements may also have benefits in terms of children's cognitive skills and future development.

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

Ranking	*1-3 Year Olds:*		*4 and 5 Year Olds:*	
	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. 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, 1987-98

Year	*Number of Annual Inspections, Day Care Centers*	*Number of Annual Inspections, Family Homes*	*Minimum Educational Requirements (Yrs of School), Day Care Center Directors*	*Minimum Educational Requirements (Yrs of School), Family Home Providers*	*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*
1987	1.00	1.05	10.92	0.00	8.2	14.1	5.6	6.6
1988	0.97	1.07	10.94	0.00	8.3	14.3	5.5	6.5
1989	0.95	1.04	10.94	0.29	8.3	14.3	5.6	6.7
1990	0.95	1.00	11.26	1.00	8.3	14.3	5.6	6.7
1991	0.95	0.98	12.27	1.24	8.3	14.4	5.6	6.8
1992	0.97	0.98	12.30	1.00	8.2	14.4	5.6	6.8
1993	0.98	0.98	12.41	1.00	8.2	14.4	5.7	6.9
1994	0.96	0.90	12.41	1.24	8.2	14.4	5.7	6.9
1995	0.91	0.90	12.41	1.24	8.2	14.3	5.7	6.9
1996	0.91	0.90	12.41	1.24	8.2	14.3	5.7	6.9
1997	1.01	0.89	12.29	1.94	8.2	14.3	5.7	6.9
1998	1.11	0.90	13.04	2.43	8.2	14.4	5.7	6.9

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	.025	.029	.030	.031	.026
Mother's Employment	.612	.601	.617	.338	.588	.709	.604	.622
Child Age	3.16	3.23	3.13	3.29	3.21	3.07	2.04	4.54
Child Male	.509	.500	.512	.525	.502	.511	.510	.507
Hispanic	.203		.279	.363	.191	.170	.199	.207
Black	.274	1.0		.325	.281	.254	.262	.289
Mother's Age	31.1	30.6	31.3	29.7	30.6	31.9	30.8	31.3
Mother Single	.306	.588	.200	.520	.345	.212	.280	.339
Younger Sib.	.225	.222	.226	.280	.218	.216	.144	.325
Older Sib.	.467	.529	.443	.622	.499	.395	.495	.432
Grandma worked when Mother 14	.512	.561	.493	.411	.503	.547	.513	.511
Grandpa worked when Mother 14	.740	.560	.808	.586	.728	.793	.746	.733
Maternal Grandma Ed.	10.6	10.6	10.7	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	37.6	20.6	44.0	10.9	29.2	52.7	38.8	36.1
No. of Obs.	49,255	13,502	35,753	6,048	20,917	22,290	27,242	22,013
No. of Children	6,702	1,800	4,902	913	2,891	2,898	5,411	5,531

Panel B: By Child Care Mode (Selected Variables)

Variables	*No Child Care*	*Day Care Centers & Pre-Schools*	*Other Non-Parental Child Care Modes*
Accident Rate	0.029	0.029	0.032
Mother's Employment	0.43	0.89	0.93
Child's Age	1.52	1.51	1.46
Child is Male	0.51	0.54	0.51
Hispanic	0.20	0.16	0.21
Black	0.26	0.36	0.26
Mother's Age	30.24	30.39	30.13
Mother Single	0.29	0.28	0.25
Younger Sibling Present	0.11	0.06	0.07
Older Sibling Present	0.56	0.42	0.48
Grandma Worked when Mother 14	0.49	0.61	0.55
Grandma Worked Data Missing	0.02	0.05	0.01
Grandpa Worked when Mother 14	0.74	0.72	0.79
Grandpa Worked Data Missing	0.20	0.25	0.15
Matern. Grandma's Educ. Attain.	10.62	11.36	10.75
Mother's Educ. Attain.	12.86	13.79	13.52
AFQT Percentile Test Score	36.34	44.32	42.11
No. of Observations	8,958	1,087	3,609

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.)	.118	0.000	7.65
Car Passenger Accidents (per 1,000)	.033	0.000	2.67
Car-Pedestrian Accidents (per 1,000)	.018	0.000	5.03
Cancer Deaths (per 1,000)	.037	0.000	3.25
CPS Variables:			
Maternal Employment Rate	.580	.338	.788
Poverty Rate	.159	.062	.277
Urban Share	.785	0.000	1.000
Hispanic Share	.177	0.000	.574
Black Share	.143	0.000	.813
Median Income (1,000s)	25.2	14.4	43.1
Mother < HS Education	.211	.011	.397
One Parent Family	.256	.078	.622
Child Care Regulations:			
Child-to-Staff Ratio, Day Care	12.3	3	25
Child-to-Staff Ratio, Family Homes	5.87	2	16
Min. Ed. Day Care Director	12.2	0	16
Min Ed. Family Home Provider	1.06	0	15
# Annual Inspections - DC	.818	0	4
# Annual Inspections - FH	.915	0	4
Distribution of Cell Sizes:			
Number of Cells	2,497		
Minimum	199		
1st Percentile	1,395		
Median	120,579		
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: Choice of Child Care Mode from Multinomial Logit Analysis, , Children, Ages 1 and 2, 1987-98
(Data Source: NLSYCM Data)
(Marginal Effects of Variables on Probability of Mode Choice Reported)

Panel A: Estimated Effects for Full Sample

Variable	Estimate	Variable	Estimate	Variable	Estimate
Day Care Centers and Preschools					
No. of Ann. Inspections, DC	-0.0193**	Single Mother	0.0080	1987	-0.0990***
	(0.0091)		(0.0092)		(0.0263)
No. of Ann. Inspections, FH	-0.0025	AFQT Percentile Test Score	0.0709***	1988	-0.0701***
	(0.0054)		(0.0185)		(0.0242)
Min. Educ. Req. of DC Directors	-0.0018**	Mother is HS Graduate	0.0387**	1989	-0.0733***
	(0.0009)		(0.0182)		(0.0259)
Min. Educ. Req. of FH Providers	0.0010	Mother has Some College	0.0569***	1990	-0.0650***
	(0.0012)		(0.0187)		(0.0238)
Child-to-Staff Ratio, DC	0.0009	Mother has College Degree	0.0432**	1991	-0.0850***
	(0.0012)		(0.0206)		(0.0250)
Child-to-Staff Ratio, FH	0.0006	Matern. Grandma HS Grad	0.0160*	1992	-0.0518**
	(0.0015)		(0.0087)		(0.0231)
Younger Sibling Present	-0.0331***	Matern. Grandma Some College	0.0070	1993	-0.1026***
	(0.0126)		(0.0137)		(0.0258)
Older Sibling Present	-0.0376***	Matern. Grandma College Grad	-0.0135	1994	-0.0396*
	(0.0078)		(0.0155)		(0.0235)
Child is Male	0.0076	Matern. Grandma's Educ. Missing	-0.0048	1995	-0.0986***
	(0.0070)		(0.0178)		(0.0255)
Hispanic	0.0113	Mother 20-29 Yrs Old	0.0004	1996	-0.0662**
	(0.0114)		(0.0306)		(0.0262)
Black	0.0377***	Mother 30-39 Yrs Old	-0.0060	1997	-0.0842***
	(0.0110)		(0.0299)		(0.0208)
Grandma Worked when Mother 14	0.0202***	Child 2 Yrs Old	-0.0015	Constant	-0.1391***
	(0.0075)		(0.0067)		(0.0467)
Grandma Worked Data Missing	0.0816***	Fall Quarter	0.0193***	*P-Values:*	
	(0.0179)		(0.0070)	Test of All Regulation Var. = 0	0.0108
Grandpa Worked when Mother 14	0.0327*	Summer Quarter	0.0187***		
	(0.0175)		(0.0065)		
Grandma Worked Data Missing	0.0462**	Spring Quarter	0.0055**		
	(0.0189)		(0.0026)		

Table 5: (Continued)

Panel A: (Continued)

Variable	Estimate	Variable	Estimate	Variable	Estimate
Other Modes of Non-Parental Child Care					
No. of Ann. Inspections, DC	-0.0104	Single Mother	0.0039	1987	0.0268
	(0.0166)		(0.0181)		(0.0673)
No. of Ann. Inspections, FH	0.0065	AFQT Percentile Test Score	0.1181***	1988	0.0356
	(0.0114)		(0.0396)		(0.0644)
Min. Educ. Req. of DC Directors	0.0043**	Mother is HS Graduate	0.1288***	1989	0.0465
	(0.0020)		(0.0303)		(0.0668)
Min. Educ. Req. of FH Providers	-0.0006	Mother has Some College	0.1874***	1990	0.0691
	(0.0027)		(0.0321)		(0.0634)
Child-to-Staff Ratio, DC	0.0040	Mother has College Degree	0.1797***	1991	-0.0282
	(0.0032)		(0.0372)		(0.0656)
Child-to-Staff Ratio, FH	-0.0041	Matern. Grandma HS Grad	-0.0445**	1992	0.0172
	(0.0030)		(0.0179)		(0.0630)
Younger Sibling Present	-0.1100***	Matern. Grandma Some College	-0.0775***	1993	-0.0725
	(0.0224)		(0.0273)		(0.0671)
Older Sibling Present	-0.0881***	Matern. Grandma College Grad	-0.1666***	1994	0.0405
	(0.0157)		(0.0350)		(0.0636)
Child is Male	-0.0049	Matern. Grandma's Educ. Missing	-0.0304	1995	-0.1573**
	(0.0140)		(0.0373)		(0.0672)
Hispanic	0.0331	Mother 20-29 Yrs Old	0.3530**	1996	-0.1309*
	(0.0227)		(0.1588)		(0.0685)
Black	0.0292	Mother 30-39 Yrs Old	0.3884**	1997	-0.1831***
	(0.0222)		(0.1584)		(0.0592)
Grandma Worked when Mother 14	0.0363**	Child 2 Yrs Old	-0.0488***	Constant	-0.6821***
	(0.0142)		(0.0156)		(0.1666)
Grandma Worked Data Missing	-0.0428	Fall Quarter	0.0123	*P-Values:*	
	(0.0583)		(0.0153)	Test of All Regulation Var. = 0	0.2601
Grandpa Worked when Mother 14	0.0152	Summer Quarter	0.0107		
	(0.0299)		(0.0142)		
Grandma Worked Data Missing	-0.0441	Spring Quarter	-0.0014		
	(0.0336)		(0.0058)		

Notes: Model also includes regional (i.e., New England, Mid Atlantic, Mountain, etc.) fixed effects.
Asymptotic standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: (Continued)

Panel B: Estimated Effects of Regulations by Race and Mother's Educational Attainment

Variables	*White*	*Black*	*< HS*	*HS*	*Any College*
Day Care Centers and Preschools					
No. of Ann. Inspections, DC	-0.0189*	-0.0128	-0.0197	-0.0042	-0.0258**
	(0.0108)	(0.0134)	(0.0367)	(0.0149)	(0.0107)
No. of Ann. Inspections, FH	-0.0042	-0.0060	0.0013	-0.0140	0.0041
	(0.0069)	(0.0086)	(0.0269)	(0.0086)	(0.0069)
Min. Educ. Req. of DC Directors	-0.0028***	-0.0001	0.0029	-0.0026**	-0.0017
	(0.0010)	(0.0014)	(0.0042)	(0.0013)	(0.0011)
Min. Educ. Req. of FH Providers	-0.0001	0.0028*	0.0003	0.0028*	0.0003
	(0.0014)	(0.0016)	(0.0054)	(0.0017)	(0.0014)
Child-to-Staff Ratio, DC	0.0029**	-0.0013	0.0011	0.0020	0.0002
	(0.0015)	(0.0019)	(0.0048)	(0.0017)	(0.0016)
Child-to-Staff Ratio, FH	0.0004	0.0014	-0.0062	-0.0032	0.0025
	(0.0019)	(0.0022)	(0.0058)	(0.0029)	(0.0017)
P-Values:					
Test of All Regulation Var. = 0	*0.0018*	0.2495	0.9114	*0.0237*	*0.0630*
Other Modes of Non-Parental Child Care					
No. of Ann. Inspections, DC	-0.0058	-0.0047	-0.0123	-0.0297	-0.0102
	(0.0199)	(0.0268)	(0.0502)	(0.0261)	(0.0211)
No. of Ann. Inspections, FH	0.0178	-0.0233	0.0072	-0.0096	0.0277*
	(0.0129)	(0.0206)	(0.0451)	(0.0162)	(0.0149)
Min. Educ. Req. of DC Directors	0.0041*	0.0043	0.0033	0.0059**	0.0039
	(0.0024)	(0.0033)	(0.0061)	(0.0029)	(0.0027)
Min. Educ. Req. of FH Providers	0.0024	-0.0089**	-0.0005	-0.0035	0.0017
	(0.0031)	(0.0045)	(0.0084)	(0.0040)	(0.0033)
Child-to-Staff Ratio, DC	0.0028	0.0072	0.0030	0.0126***	-0.0050
	(0.0038)	(0.0044)	(0.0070)	(0.0040)	(0.0040)
Child-to-Staff Ratio, FH	-0.0014	-0.0118*	0.0031	-0.0074	-0.0020
	(0.0034)	(0.0064)	(0.0099)	(0.0048)	(0.0041)
P-Values:					
Test of All Regulation Var. = 0	0.5067	*0.0559*	0.9859	0.0130	0.2552

Notes: The models in Panel B also included all of the variables included in Panel A.
Asymptotic standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Estimates of the Effects of Child Care Regulations on Accidents, Children, Ages 1-5, 1987-98, Includes State Fixed Effects
(Data Source: NLSYCM)

Panel A: Estimated Effects for Full Sample

Variable	Estimate	Variable	Estimate	Variable	Estimate
No. of Ann. Inspections, DC	-0.00002	AFQT Score Missing	-0.0066	Spring Quarter	0.0314***
	(0.0027)		(0.0043)		(0.0026)
No. of Ann. Inspections, FH	-0.0036	Mother is HS Graduate	0.0007	1987	-0.0905***
	(0.0058)		(0.0027)		(0.0077)
Min. Educ. Req. of DC Directors	-0.0012**	Mother has Some College	0.0008	1988	-0.0062
	(0.0005)		(0.0031)		(0.0060)
Min. Educ. Req. of FH Providers	-0.0001	Mother has College Degree	-0.0035	1989	-0.0857***
	(0.0004)		(0.0039)		(0.0079)
Child-to-Staff Ratio, DC	0.00002	Mother's Educ. Missing	-0.0145	1990	-0.0154***
	(0.0003)		(0.0233)		(0.0057)
Child-to-Staff Ratio, FH	-0.0008	Matern. Grandma HS Grad	0.0009	1991	-0.0863***
	(0.0005)		(0.0021)		(0.0074)
Younger Sibling Present	-0.0063***	Matern. Grandma Some College	-0.0033	1992	-0.0038
	(0.0021)		(0.0031)		(0.0057)
Older Sibling Present	0.0020	Matern. Grandma College Grad	0.0025	1993	-0.0884***
	(0.0021)		(0.0045)		(0.0075)
Child is Male	0.0090***	Matern. Grandma's Educ. Missing	0.0021	1994	-0.0188***
	(0.0016)		(0.0034)		(0.0053)
Hispanic	-0.0099***	Mother 20-29 Yrs Old	0.0121	1995	-0.0775***
	(0.0028)		(0.0099)		(0.0069)
Black	-0.0156***	Mother 30-39 Yrs Old	0.0081	1996	-0.0015
	(0.0025)		(0.0096)		(0.0060)
Grandma Worked when Mother 14	0.0019	Child 2 Yrs Old	0.0089***	1997	-0.0757***
	(0.0017)		(0.0030)		(0.0066)
Grandma Worked Data Missing	0.0021	Child 3 Yrs Old	0.0082**	Constant	0.0248*
	(0.0066)		(0.0034)		(0.0134)
Grandpa Worked when Mother 14	0.0042	Child 4 Yrs Old	0.0026	Observations	49,255
	(0.0033)		(0.0038)	R^2	0.02
Grandpa Worked Data Missing	0.0031	Child 5 Yrs Old	0.0037		
	(0.0036)		(0.0046)	*P-Values:*	
Single Mother	0.0059***	Fall Quarter	0.0726***	Test of Inspection Regs = 0	0.8053
	(0.0020)		(0.0054)	Test of Educ. Req. Regs = 0	*0.0223*
AFQT Percentile Test Score	0.0002***	Summer Quarter	0.0797***	Test of Child-Staff Ratio Regs = 0	0.3397
	(0.00005)		(0.0055)	Test of All Regulation Var. = 0	0.1203

Notes: Model also includes state fixed effects.
Asymptotic standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: (Continued)

Panel B: Estimated Effects of Regulations by Race, Mother's Educational Attainment, Children's Age and Mother's Work Status

Variable	Whites	Blacks	< HS	HS	Any College	Ages 1-3	Ages 4-5	Mother Does Not Work	Mother Works
No. of Ann. Inspections, DC	-0.0008	0.0013	0.0062	-0.0001	-0.0014	0.0012	-0.0012	-0.0001	-0.0002
	(0.0031)	(0.0032)	(0.0064)	(0.0033)	(0.0031)	(0.0031)	(0.0031)	(0.0033)	(0.0029)
No. of Ann. Inspections, FH	-0.0032	-0.0055	-0.0026	-0.0043	-0.0033	-0.0049	-0.0017	-0.0045	-0.0029
	(0.0058)	(0.0063)	(0.0064)	(0.0059)	(0.0059)	(0.0059)	(0.0059)	(0.0058)	(0.0060)
Min. Educ. Req. of DC Directors	-0.0013**	-0.0012**	-0.0002	-0.0013***	-0.0013**	-0.0017***	-0.0008	-0.0007	-0.0015***
	(0.0006)	(0.0005)	(0.0006)	(0.0005)	(0.0006)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Min. Educ. Req. of FH Providers	-0.0001	-0.0002	0.0015	-0.0002	-0.0004	-0.0004	0.0002	-0.0007	0.0002
	(0.0004)	(0.0004)	(0.0012)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0005)	(0.0004)
Child-to-Staff Ratio, DC	0.0001	-0.0002	0.0003	0.0001	-0.0001	-0.0009	0.0001	0.0004	-0.0002
	(0.0004)	(0.0004)	(0.0005)	(0.0004)	(0.0004)	(0.0006)	(0.0004)	(0.0004)	(0.0004)
Child-to-Staff Ratio, FH	-0.0016***	0.0004	-0.0019***	-0.0005	-0.0007	-0.0006	-0.0012*	-0.0006	-0.0009
	(0.0006)	(0.0008)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0006)	(0.0006)	(0.0007)
R^2	0.02			0.02		0.02		0.03	
P-Values:									
Test of Inspection Regs = 0	0.7883	0.6793	0.6024	0.7455	0.635	0.6968	0.8456	0.7144	0.8601
Test of Educ. Req. Regs = 0	*0.0984*	*0.0151*	0.4351	*0.0173*	*0.0298*	*0.0017*	0.2788	*0.0696*	*0.0105*
Test of Child-Staff Ratio Regs = 0	*0.0178*	0.7306	*0.0298*	0.7887	0.4958	0.1725	0.1561	0.3622	0.3354
Test of All Regulation Var. = 0	*0.0455*	0.1541	0.1736	0.1551	0.1329	*0.0192*	0.3498	0.2615	*0.0783*

Notes: Models in Panel B also included all of the variables included in Panel A models.
Asymptotic standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Estimates of the Effects of Child Care Regulation on Accidents, Children, Ages 1-5, 1987-98
Includes Child and State Fixed Effects
(Data Source: NLSYCM)

Panel A: Estimated Effects for Full Sample

Variable	Estimate	Variable	Estimate	Variable	Estimate
No. of Ann. Inspections, DC	-0.0012	Child 3 Yrs Old	0.0131**	1993	-0.0863***
	(0.0045)		(0.0065)		(0.0149)
No. of Ann. Inspections, FH	-0.0032	Child 4 Yrs Old	0.0084	1994	-0.0108
	(0.0081)		(0.0091)		(0.0119)
Min. Educ. Req. of DC Directors	-0.0019**	Child 5 Yrs Old	0.0129	1995	-0.0762***
	(0.0007)		(0.0118)		(0.0105)
Min. Educ. Req. of FH Providers	-0.0003	Fall Quarter	0.0754***	1996	0.0035
	(0.0006)		(0.0042)		(0.0079)
Child-to-Staff Ratio, DC	0.000003	Summer Quarter	0.0811***	1997	-0.0841***
	(0.0004)		(0.0036)		(0.0072)
Child-to-Staff Ratio, FH	-0.0009	Spring Quarter	0.0309***	Constant	0.0228
	(0.0006)		(0.0023)		(0.0306)
Younger Sibling Present	-0.0083**	1987	-0.0768***		
	(0.0033)		(0.0293)	Total No. of Observations	49,255
Older Sibling Present	-0.0007	1988	0.0088	Number of Children	6,702
	(0.0044)		(0.0268)	R^2	0.02
Single Mother	0.0188	1989	-0.0768***		
	(0.0134)		(0.0243)	*P-Values:*	
Mother 20-29 Yrs Old	0.0159	1990	-0.0029	Test of Inspection Regs = 0	0.8678
	(0.0129)		(0.0217)	Test of Educ. Req. Regs = 0	*0.0243*
Mother 30-39 Yrs Old	0.0160	1991	-0.0797***	Test of Child-Staff Ratio Regs = 0	0.3436
	(0.0129)		(0.0193)	Test of All Regulation Var. = 0	0.1412
Child 2 Yrs Old	0.0101**	1992	0.0060		
	(0.0042)		(0.0167)		

Notes: Model also includes state fixed effects.
Asymptotic standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: (Continued)

Panel B: Estimated Effects of Regulations by Race, Mother's Educational Attainment, Children's Age and Mother's Work Status

Variable	Whites	Blacks	< HS	HS	Any College	Ages 1-3	Ages 4-5	Mother Does Not Work	Mother Works
No. of Ann. Inspections, DC	-0.0021	0.0013	-0.0027	0.0030	-0.0047	-0.0003	-0.0006	-0.0037	-0.0009
	(0.0057)	(0.0067)	(0.0125)	(0.0065)	(0.0060)	(0.0048)	(0.0050)	(0.0056)	(0.0048)
No. of Ann. Inspections, FH	-0.0034	-0.0018	0.0057	-0.0068	-0.0006	-0.0033	0.0008	-0.0032	-0.0021
	(0.0083)	(0.0127)	(0.0129)	(0.0091)	(0.0100)	(0.0083)	(0.0086)	(0.0083)	(0.0083)
Min. Educ. Req. of DC Directors	-0.0030***	-0.0009	-0.0007	-0.0022**	-0.0018*	-0.0020***	-0.0019**	-0.0007	-0.0026***
	(0.0010)	(0.0009)	(0.0018)	(0.0010)	(0.0010)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Min. Educ. Req. of FH Providers	0.0001	-0.0010	-0.0002	-0.0006	0.00005	-0.0011	-0.00007	-0.0015*	0.0004
	(0.0007)	(0.0009)	(0.0015)	(0.0009)	(0.0008)	(0.0007)	(0.0006)	(0.0008)	(0.0006)
Child-to-Staff Ratio, DC	-0.0000001	0.00001	0.0008	0.00001	-0.0002	-0.0011*	-0.0001	0.0005	-0.0003
	(0.0005)	(0.0005)	(0.0007)	(0.0005)	(0.0005)	(0.0007)	(0.0005)	(0.0005)	(0.0005)
Child-to-Staff Ratio, FH	-0.0020**	0.0006	-0.0014	0.0006	-0.0025***	-0.0005	-0.0019**	-0.0005	-0.0013
	(0.0008)	(0.0010)	(0.0016)	(0.0009)	(0.0009)	(0.0007)	(0.0009)	(0.0009)	(0.0008)
R^2	0.02			0.02		0.02		0.03	
P-Values									
Test of Inspection Regs = 0	0.8365	0.9793	0.9046	0.7182	0.7036	0.9114	0.9893	0.6873	0.9371
Test of Educ. Req. Regs = 0	*0.0114*	0.2537	0.9081	*0.0349*	0.2038	*0.0034*	*0.0707*	*0.0722*	*0.0039*
Test of Child-Staff Ratio Regs = 0	*0.0521*	0.8182	0.4238	0.7768	*0.0238*	0.2143	0.1025	0.5516	0.2149
Test of All Regulation Var. = 0	*0.0217*	0.7811	0.8972	0.2368	*0.0249*	*0.0272*	0.1132	0.3284	*0.0298*

Notes: Models in Panel B included the same variables as the models in Panel A.
Asymptotic standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: Child Care Regulation and Deaths, Children Ages 1 – 9
(Data Source: Vital Statistics Mortality Data)

Panel A: Effects Estimated over Period 1987-98

Variable	Cause of Death:			
	Non-Car Accident	Car Pedestrian Accident	Car Passenger Accident	Cancer
No. of Ann. Inspections, DC	-0.0004	0.0005	-0.0040**	0.0014
	(0.0046)	(0.0011)	(0.0016)	(0.0016)
No. of Ann. Inspections, FH	-0.0075	-0.0032**	0.0034	-0.0007
	(0.0061)	(0.0014)	(0.0021)	(0.0022)
Min. Educ. Req. of DC Directors	0.0011	-0.0002	-0.0003	-0.0001
	(0.0007)	(0.0002)	(0.0002)	(0.0003)
Min. Educ. Req. of FH Providers	-0.0003	-0.0005***	-0.0001	0.0001
	(0.0006)	(0.0001)	(0.0002)	(0.0002)
Child-to-Staff Ratio, DC	-0.0034***	-0.00005	-0.0002	0.00003
	(0.0006)	(0.0001)	(0.0002)	(0.0002)
Child-to-Staff Ratio, FH	0.0004	0.0002	-0.0010***	-(0.0004
	(0.0011)	(0.0003)	(0.0004)	(0.0004)
No. of Ann. Inspections, DC × Young	**0.0039**	**-0.0001**	**0.0032****	**-0.0012**
	(0.0042)	**(0.0010)**	**(0.0015)**	**(0.0015)**
No. of Ann. Inspections, FH × Young	**0.0113*****	**0.0003**	**-0.0006**	**0.0008**
	(0.0031)	**(0.0007)**	**(0.0011)**	**(0.0011)**
Min. Educ. Req. of DC Directors × Young	**-0.0009***	**0.0002**	**0.00005**	**-0.0002**
	(0.0006)	**(0.0001)**	**(0.0002)**	**(0.0002)**
Min. Educ. Req. of FH Providers × Young	**-0.0004**	**0.0005*****	**0.0002**	**-0.0003**
	(0.0006)	**(0.0001)**	**(0.0002)**	**(0.0002)**
Child-to-Staff Ratio, DC × Young	**0.0019****	**0.0001**	**0.0009*****	**(0.0001**
	(0.0010)	**(0.0002)**	**(0.0003)**	**(0.0004)**
Child-to-Staff Ratio, FH × Young	**0.0029***	**0.0001**	**0.0011***	**0.0001**
	(0.0016)	**(0.0004)**	**(0.0006)**	**(0.0006)**
Child Black	0.1248***	0.0167***	0.0069***	-0.0009
	(0.0030)	(0.0007)	(0.0010)	(0.0011)
Young Children (Ages 1-4)	0.0605***	-0.0089**	-0.0157***	(0.0058
	(0.0158)	(0.0036)	(0.0054)	(0.0056)
Working Mom	0.0203	0.0034	0.0028	0.0086
	(0.0391)	(0.0090)	(0.0135)	(0.0139)
Black	0.0020	0.0082	0.0264	-0.0245
	(0.0640)	(0.0146)	(0.0221)	(0.0228)
Hispanic	-0.0133	-0.0065	-0.0203	0.0142
	(0.0630)	(0.0144)	(0.0217)	(0.0224)
Median Income	7.04E-08	4.97E-07*	6.56E-08	-5.79E-08
	(1.16E-06)	(2.60E-07)	(4.00E-07)	(4.10E-07)
Mother with HS Degree	0.0252	-0.0025	-0.0067	-0.0222
	(0.0531)	(0.0121)	(0.0183)	(0.0189)
Single Parent Household	-0.0241	0.0163	-0.0078	0.0118
	(0.0519)	(0.0119)	(0.0179)	(0.0185)
Poverty	-0.0088	0.0138	-0.0290	-0.0029
	(0.1049)	(0.0240)	(0.0362)	(0.0374)
R^2	0.76	0.41	0.49	0.23

Notes: Standard errors in parentheses. Models also include state and year dummies. There were 1990 cells. All estimates weighted by cell size.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: (Continued)

Panel B: Effects Estimated over Period 1983-98

Variable	Cause of Death:			
	Non-Car Accident	**Car Pedestrian Accident**	**Car Passenger Accident**	**Cancer**
No. of Ann. Inspections, DC	-0.0009	0.0001	-0.0028**	0.0016
	(0.0040)	(0.0010)	(0.0014)	(0.0014)
No. of Ann. Inspections, FH	-0.0098**	-0.0013	0.0001	-0.0004
	(0.0048)	(0.0012)	(0.0017)	(0.0017)
Min. Educ. Req. of DC Directors	0.0009	-0.0003**	-0.0001	-0.0001
	(0.0006)	(0.0001)	(0.0002)	(0.0002)
Min. Educ. Req. of FH Providers	-0.0004	-0.0004***	-0.0001	0.0001
	(0.0006)	(0.0001)	(0.0002)	(0.0002)
Child-to-Staff Ratio, DC	-0.0030***	-0.00001	-0.0002	-0.0001
	(0.0005)	(0.0001)	(0.0002)	(0.0002)
Child-to-Staff Ratio, FH	(0.0010)	(0.0003)	(0.0004)	(0.0004)
	-0.0001	0.0002	-0.0008**	-0.0005
No. of Ann. Inspections, DC × Young	**0.0026**	**0.0011**	**0.0037*** **	**-0.0023***
	(0.0036)	**(0.0009)**	**(0.0013)**	**(0.0013)**
No. of Ann. Inspections, FH × Young	**0.0090*** **	**-0.0006**	**-0.0006**	**0.0004**
	(0.0026)	**(0.0007)**	**(0.0009)**	**(0.0009)**
Min. Educ. Req. of DC Directors × Young	**-0.0012*** **	**0.0001**	**0.0001**	**-0.0001**
	(0.0005)	**(0.0001)**	**(0.0002)**	**(0.0002)**
Min. Educ. Req. of FH Providers × Young	**-0.0006**	**0.0005*** **	**0.0002**	**-0.0003**
	(0.0006)	**(0.0001)**	**(0.0002)**	**(0.0002)**
Child-to-Staff Ratio, DC × Young	**0.0029*** **	**0.0002**	**0.0009*** **	**0.00004**
	(0.0009)	**(0.0002)**	**(0.0003)**	**(0.0003)**
Child-to-Staff Ratio, FH × Young	**0.0019**	**0.00004**	**0.0008**	**0.0001**
	(0.0015)	**(0.0004)**	**(0.0005)**	**(0.0005)**
Child Black	0.1273***	0.0180***	0.0048***	-0.0014
	(0.0027)	(0.0007)	(0.0009)	(0.0009)
Young Children (Ages 1-4)	0.0673***	-0.0091***	-0.0151***	0.0054
	(0.0137)	(0.0035)	(0.0048)	(0.0048)
Working Mom	0.0487	0.0084	0.0124	0.0249**
	(0.0342)	(0.0086)	(0.0119)	(0.0120)
Black	-0.0118	0.0094	0.0267	-0.0245
	(0.0521)	(0.0131)	(0.0181)	(0.0183)
Hispanic	-0.0511	-0.0180	-0.0168	-0.0003
	(0.0532)	(0.0133)	(0.0185)	(0.0187)
Median Income	-9.39E-08	5.00E-07*	2.30E-09	-8.46E-08
	(1.03E-06)	(2.60E-07)	(3.60E-07)	(3.60E-07)
Mother with HS Degree	0.0227	0.0029	-0.0199	-0.0133
	(0.0430)	(0.0108)	(0.0150)	(0.0151)
Single Parent Household	-0.0052	0.0152	-0.0045	0.0079
	(0.0463)	(0.0116)	(0.0161)	(0.0163)
Poverty	-0.0124	0.0066	-0.0497	-0.0039
	(0.0919)	(0.0231)	(0.0320)	(0.0323)
R^2	0.76	0.42	0.47	0.24

Notes: Standard errors in parentheses. Models also include state and year dummies. There were 2497 cells. All estimates weighted by cell size.
* significant at 10%; ** significant at 5%; *** significant at 1%