Parental Incarceration and Child Mortality in Denmark

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Objectives. We used Danish registry data to examine the association between parental incarceration and child mortality risk.

Methods. We used a sample of all Danish children born in 1991 linked with parental information. We conducted discrete-time survival analysis separately for boys (n = 30 146) and girls (n = 28 702) to estimate the association of paternal and maternal incarceration with child mortality, controlling for parental sociodemographic characteristics. We followed the children until age 20 years or death, whichever came first.

Results. Results indicated a positive association between paternal and maternal imprisonment and male child mortality. Paternal imprisonment was associated with lower child mortality risks for girls. The relationship between maternal imprisonment and female child mortality changed directions depending on the model, suggesting no clear association.

Conclusions. These results indicate that the incarceration of a parent may influence child mortality but that it is important to consider the gender of both the child and the incarcerated parent. (*Am J Public Health.* 2014;104:428–433. doi:10.2105/AJPH.2013.301590)

A substantial body of research has found that mortality and morbidity among men is associated with ever being incarcerated, the period of incarceration, and the immediate postrelease period.[1–10] In a similar vein, a small but rapidly growing body of research considers how these incarceration experiences might also affect the health of the women who are associated with incarcerated men.[11–14]

Yet the health consequences of imprisonment need not be limited to adults. Recent research demonstrates that the risk of parental imprisonment has increased in lockstep with the risk of imprisonment for men[14] and that paternal incarceration is associated with poor child outcomes in a variety of domains,[15,16] including increased behavioral problems,[17,18] criminality and arrest,[19] drug use,[20] and educational detainment.[21,22] Although many previous studies suggest that paternal incarceration has global negative effects on their children, some research shows that paternal incarceration's consequences vary by the gender of the child, as paternal incarceration is associated with increases in the aggression of boys but not girls.[23] Paternal incarceration is associated with decreases in the aggression of girls, indicating that its effects on girls may be positive, negative, or null. The consequences of maternal imprisonment for children have received less attention.[24] Furthermore, findings on the association of maternal incarceration with child well-being are more equivocal, indicating a less clear-cut relationship between maternal incarceration and poor child outcomes.[25,26]

Despite this previous research on parental incarceration and child well-being and a growing body of evidence indicating that other national-level social policies, such as parental leave and antipoverty programs, have important implications for child health outcomes,[27–31] little research has considered the relationship between parental incarceration and child health. Indeed, with the exception of 2 studies linking paternal incarceration with elevated risks of infant mortality for all children[32] and obesity among young women,[33] we know virtually nothing about how parental incarceration shapes child health, which is especially problematic since increasing rates of imprisonment matter not just for adult men but also for their children.[14]

We have extended the literature on the consequences of parental incarceration for child health by considering the relationship between paternal and maternal incarceration and child mortality in Denmark using data from the Danish administrative registers.

METHODS

To consider the association between parental incarceration and child mortality in Denmark, we used data from the Danish administrative registers. All residents in Denmark have a unique personal identification number linked to records with information on contact with the welfare system, place of residence, marital status, educational attainment, work status, and contact with the criminal justice system, including incarceration. Statistics Denmark collects the information registered by this identification number on an annual basis. It makes these data, which go back to 1980 and comprise the full population of Danish residents, available for research. The administrative data were well-suited for the purpose of our study. We had access to individual-level data on when a person was imprisoned, we could link parents to children, and we knew the exact day a person died. This unique feature allowed us to relate child mortality to the incarceration histories of fathers and mothers, and because we also had information on the sociodemographic characteristics of parents, we were able to adjust for these characteristics.

From the administrative data, we used all children born in 1991 as our starting population and observed them annually until they died or reached age 20 years. We linked these children to their parents and used only information on children for whom we had information on both parents (n = 58 848). Unlike with traditional survey data collected over a long period, we had virtually no missing data. Because we observed each child for up to 20 years, we had 1 232 433 individual-by-year observations. We conducted separate analysis for boys (n = 30 146) and girls (n = 28 702).

Predictor and Outcome Variables

Our key predictor variables were paternal and maternal incarceration. We constructed 2

variables for each parent. The first indicated whether the parent was incarcerated between the year the child was born and a given year *t*. The second indicated whether the parent was incarcerated between year $t+1$ and the child's 20th birthday. The latter is a measure of leaded incarceration (which has nothing to do with lead [Pb] content and everything to do with timing). Including a leaded measure of incarceration allowed us to diminish concerns about unobserved traits of parents driving any associations herein because future incarceration, of which leaded incarceration is a direct measure, cannot have a causal effect on current mortality risk.

Our outcome was child mortality. For each year, we recorded whether the child died that year and we constructed a dummy variable, taking the value 1 if the child died and 0 otherwise. The outcome was right-censored at child age 20 years, meaning we stopped following children at age 20 years. To adjust for changes in mortality rates across age, we included annual dummies for child age in all models.

Control Variables and Statistical Analysis

Our models included a range of control variables that we expected to affect both child mortality and parental incarceration. These variables were all measured the year prior to the child's birth, and we included the same variables for both parents. We included a dummy variable for education (whether they had only compulsory education), the natural logarithm of yearly wages, proportion of the year spent unemployed, whether they were single parents, how many children they had, their immigrant status, and their age at the child's birth.

To estimate the association of paternal and maternal incarceration with child mortality for boys and girls, we used discrete-time survival analysis. We first plotted the Kaplan–Meier estimates of the survival rates for children of incarcerated and nonincarcerated parents across the age of the children, presenting all results separately by child's gender. We then estimated multivariate hazard models, successively including more rigorous control variables, again separately by child's gender. To test whether the association between parental incarceration and child mortality was a result of unmeasured variables causing both incarceration and child mortality—a selection effect—we included the leaded parental incarceration variables in the multivariate models. If leaded parental incarceration was associated with child mortality, this may have been the result of a common, unmeasured cause.[34] We modeled the hazard rate at child age *t* with logistic regression models. All models included a nonparametric specification of the child's age. Because child mortality is a rare event, the odds ratios could be interpreted as risk ratios. We corrected all standard errors for the clustering of observations caused by the panel design.

Research on the interpretation of coefficients from logistic regression models suggests that these coefficients cannot be directly compared across nested models without and with control variables because of an attenuation bias caused by the statistical identification of the logistic regression model.[35,36] To address this bias, we applied a method that rescaled the coefficients of all models to the scale of the full model, making direct comparisons across models possible.[37]

RESULTS

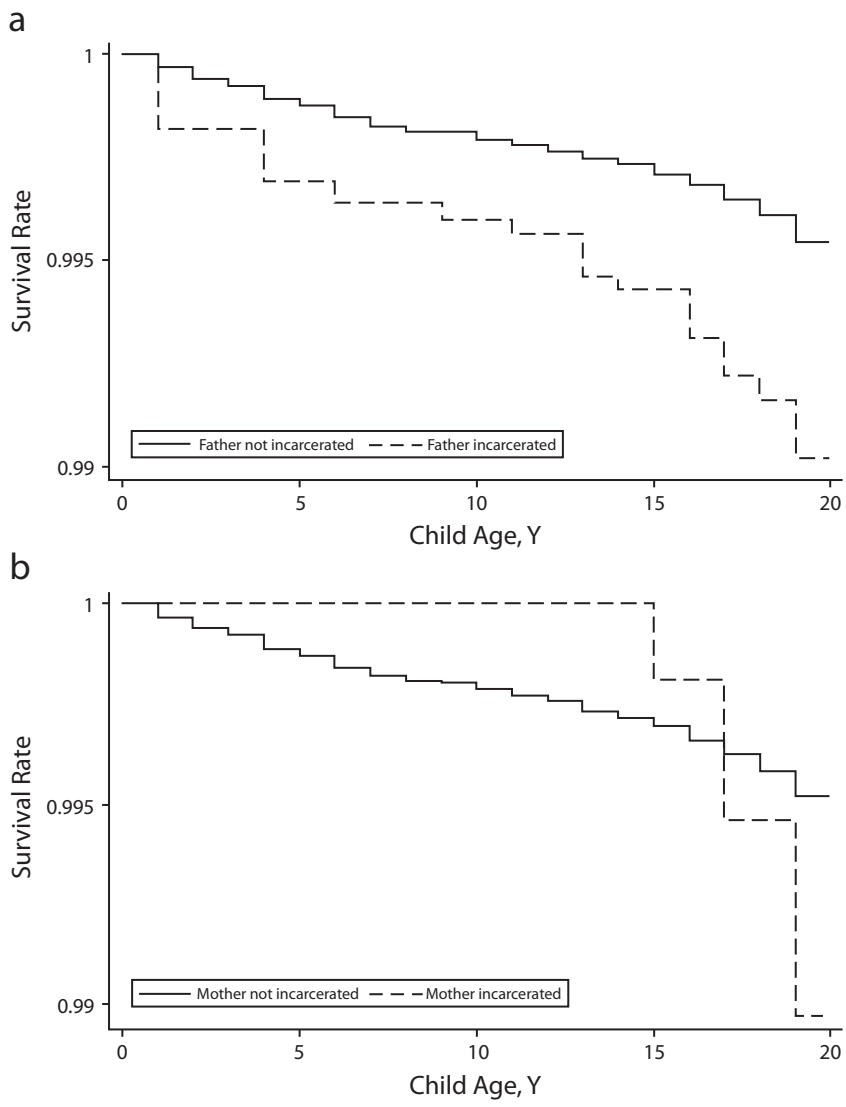
In total, 293 children (5 per 1000) died during our 20-year observation period, reflecting the low child mortality rate in Denmark. As shown in Table 1, we found that the child mortality rate was higher among boys (6 per 1000) than among girls (4 per 1000). Among all children, 12% experienced their father being incarcerated during the observation period, whereas only about 2% of children experienced their mother being incarcerated. Of boys who died, 24 had a father incarcerated and 6 had a mother incarcerated; of girls who died, 4 had a father incarcerated and 1 had a mother incarcerated. Estimates other than those for the paternal incarceration–male child mortality relationship may thus be somewhat unstable (as shown in the confidence intervals).

Figure 1 shows the survival probabilities of boys whose fathers and mothers were and were not incarcerated between the boys' birth and their 20th birthday. As Figure 1a shows, we found steeper declines for boys of

TABLE 1—Characteristics of Incarcerated Parents: Denmark, 1991–2011

Variable	Boys	Girls	All
Mortality rate, per 1000	6	4	5
Father's characteristics			
Incarcerated between child's birth and year *t*, proportion	0.120	0.120	0.120
Incarcerated between $t+1$ and child's 20th birthday, proportion	0.120	0.120	0.120
Completed only compulsory education, proportion	0.700	0.710	0.710
Mean annual wage, ln	12.150	12.160	12.150
Single, proportion	0.210	0.210	0.210
No. of children, mean	0.660	0.660	0.660
Proportion of year spent unemployed	0.082	0.084	0.083
Immigrant, proportion	0.080	0.080	0.080
Age, y, mean	29.440	29.500	29.470
Mother's characteristics			
Incarcerated between child's birth and year *t*, proportion	0.020	0.020	0.020
Incarcerated between $t+1$ and child's 20th birthday, proportion	0.020	0.020	0.020
Completed only compulsory education, proportion	0.660	0.670	0.670
Mean annual wage, ln	11.420	11.430	11.430
Single, proportion	0.190	0.200	0.190
No. of children, mean	0.730	0.730	0.730
Proportion of year spent unemployed	0.143	0.143	0.143
Immigrant, proportion	0.070	0.070	0.070
Age, y, mean	26.700	26.720	26.710

Note. ln = natural log.



Note. The boys were born in 1991 and were followed until age 20 years or death, whichever came first.

FIGURE 1—Survival rates for boys of incarcerated and nonincarcerated (a) fathers and (b) mothers: Denmark, 1991–2011.

incarcerated fathers than for other boys. As Figure 1b shows, from birth to age 16 years, boys of incarcerated mothers were more likely to survive than were boys of mothers who did not experience incarceration. However, this trend reversed at age 16 years, with boys of incarcerated mothers experiencing a sharp increase in the risk of mortality relative to other boys.

Table 2 reports the associations, estimated with logistic response models, between parental incarceration and mortality risks for boys. Model B1 shows that boys of fathers who were incarcerated between the child's birth and time t were about 2.26 times more likely to die than were other boys. This risk ratio was statistically significant ($P<.01$) and was robust to adjustment for paternal sociodemographic characteristics (model B2), leaded paternal incarceration (model B3), and maternal characteristics (model B7). Models B3 and B7 also revealed no strong or statistically significant differences in mortality risks between fathers who were incarcerated after $t+1$, suggesting that the reported association between paternal incarceration and boys' mortality risk was robust to omitted variables in this regard.

In model B4, we found that boys of mothers who were incarcerated between the child's birth and t were 2.84 times more likely to die than were other boys. This risk ratio was robust to adjustment for maternal sociodemographics (model B5) and leaded maternal incarceration (model B6), but the risk ratio was not statistically significant at the $P<.05$ level once we adjusted for paternal characteristics (model B7). The reduction in the association between models B6 and B7 suggests that controlling for paternal characteristics explained about 25% of the association. The adjusted risk ratio of 2.22 in model B7 was nonetheless substantial and close to that reported for paternal incarceration. As with leaded paternal incarceration, we found no evidence of a strong association between leaded maternal incarceration (models B6 and B7) and child mortality risks, suggesting the robustness of the results to unmeasured confounders.

Figure 2 shows the survival rates of girls by parental incarceration. As Figure 2a shows, girls of incarcerated fathers were less likely to die throughout the observation period. Similarly, as Figure 2b shows, girls of incarcerated mothers were always more likely to survive than other girls. Although we found a steady decline in the survival rate for girls whose mothers did not experience incarceration, we did not see a marked decline for girls of incarcerated mothers before age 18 years.

Table 2 also reports the associations between parental incarceration and the mortality risks of girls. None of the reported risk ratios were statistically significant at the $P<.05$ level, which is not unsurprising given the small number of cases of maternal incarceration in our data. Because our sample was a population, however, we took these risk ratios as valuable descriptions of the differential mortality rates between girls of incarcerated parents and other girls. Model G1 shows that girls of fathers who were incarcerated between the child's birth and t were $0.54^{-1}=1.84$ times less likely to die than were other girls. However, this inverse risk ratio reduced to $0.76^{-1}=1.32$ once we adjusted for paternal sociodemographic characteristics (model G2), suggesting that 54% of the association could be explained by these

TABLE 2—Results From Discrete-Time Hazard Models Considering the Association Between Paternal and Maternal Incarceration and Child Mortality Risk: Denmark, 1991–2011

	Father Incarcerated		Mother Incarcerated	
Model	Between Child's Birth and Year *t*, RR (95% CI)	Between *t* + 1 and Child's 20th Birthday, RR (95% CI)	Between Child's Birth and Year *t*, RR (95% CI)	Between *t* + 1 and Child's 20th Birthday, RR (95% CI)
Boys				
B1	2.26** (1.31, 3.94)			
B2	2.40** (1.45, 4.01)			
B3	2.46** (1.49, 4.06)	0.86 (0.42, 1.73)		
B4			2.84* (1.15, 6.96)	
B5			2.92* (1.17, 7.24)	
B6			2.87* (1.15, 7.10)	1.23 (0.30, 5.00)
B7	2.26** (1.35, 3.82)	0.82 (0.39, 1.69)	2.22 (0.86, 5.75)	1.18 (0.29, 3.46)
Girls				
G1	0.54 (0.19, 1.54)			
G2	0.76 (0.27, 2.10)			
G3	0.77 (0.26, 2.25)	0.86 (0.36, 2.05)		
G4			0.77 (0.11, 5.53)	
G5			1.17 (0.15, 9.12)	
G6			1.07 (0.11, 9.78)	2.62 (0.80, 8.50)
G7	0.78 (0.28, 2.23)	0.84 (0.34, 2.05)	1.25 (0.17, 9.12)	2.86 (0.86, 9.49)

Note. CI = confidence interval; RR = risk ratio. All risk ratios were measured on the scale of models G7 and B7 (the full model). All models were controlled for a nonparametric specification of child age. Models were as follows: B1 and G1: adjusted for child's age; B2 and G2: adjusted for child's age and paternal sociodemographic characteristics; B3 and G3: adjusted for child's age and paternal sociodemographic characteristics; B4 and G4: adjusted for child's age; B5 and G5: adjusted for child's age and maternal sociodemographic characteristics; B6 and G6: adjusted for child's age and maternal sociodemographic characteristics; B7 and G7: adjusted for child's age and for paternal and maternal sociodemographic characteristics.
*$P < .05$; **$P < .01$.

characteristics. The paternal incarceration estimate in model G2 was robust to adjustment for leaded paternal incarceration (model G3) and maternal characteristics (model G7). In models G3 and G7, we found that, similar to the results for boys, there was no strong association between leaded paternal incarceration and child mortality risks, again suggesting that these results were likely robust to unmeasured confounders.

Model G4 shows that girls of mothers who were incarcerated between the child's birth and *t* were $0.77^{-1} = 1.30$ times less likely to die than were other girls. However, adjusting for maternal sociodemographic characteristics (model G5) reversed the sign of the risk ratio, with girls of incarcerated mothers now being 17% more likely to die than other girls. Further adjustment for leaded maternal incarceration reduced this to 7% (model G6), and adjustment for paternal characteristics increased it to 25% (model G7). However, in models G6 and G7, we found large risk ratios of greater than 2.60 for leaded maternal incarceration, indicating that our incarceration estimates for girls may have been prone to selection bias caused by omitted confounders. Our finding that the signs reversed across models was another sign of such bias. Thus, results suggest that the association between maternal incarceration and mortality risk for girls was unclear.

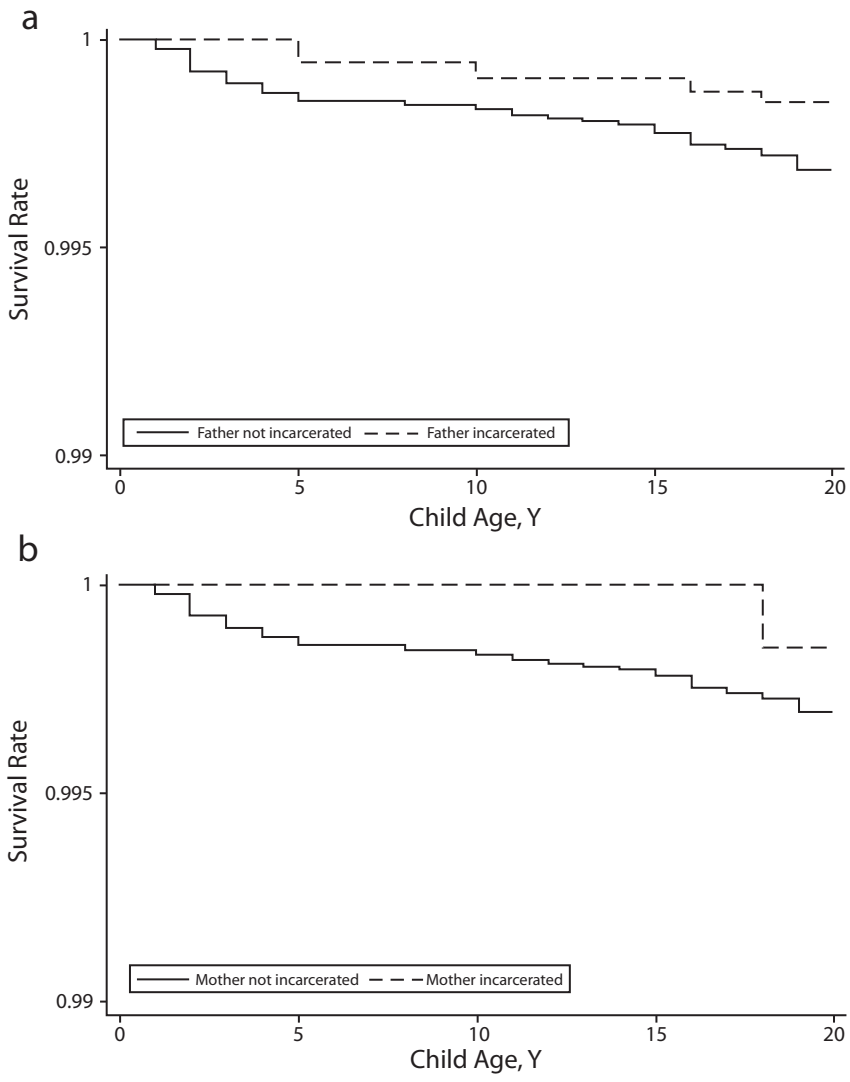
DISCUSSION

This study extends research on the collateral consequences of incarceration for the health of the family members of prisoners by using data from the Danish administrative registers to estimate the association between paternal and maternal incarceration and the mortality risk of boys and girls. By considering paternal and maternal incarceration, as well as the mortality risks of boys and girls, we provide the first evidence of gender-specific associations using administrative data.

In addition to examining paternal and maternal incarceration simultaneously and considering boys and girls separately, the current study also makes 2 other key contributions. Perhaps most importantly, the outcome we used, child mortality, is generally considered one of the best markers of child health in a population, allowing us to better understand the larger public health consequences of imprisonment. Second, the data we used also included complete information on parental incarceration histories and child mortality, meaning our analysis avoided problems of attrition and nonresponse, which are both serious limitations inherent to most longitudinal and cross-sectional studies on the effects of parental incarceration on children.

In terms of the paternal incarceration–child mortality relationship, we found support for a number of conclusions. Most importantly, the relationship between paternal incarceration and the mortality risk of boys was substantial and statistically significant in all models. We found similar, but statistically insignificant, results for maternal incarceration. However, because we used population data, the magnitude of the association remains informative. On the basis of our results, boys of incarcerated fathers were about twice as likely to die as were other boys. Because child mortality rates are a solid gauge of the health of children in a society, our results suggest important public health implications of imprisonment and its correlates. For girls, however, we found no evidence of a significant association between paternal incarceration and the risk of mortality. Nonetheless, the direction of the relationship is instructive because we used a population sample, and in each case, paternal incarceration was associated with a 28% decrease in their mortality risk.

The gender-specific association of paternal incarceration with child mortality is consistent with previous research on paternal incarceration and child well-being more broadly,[23,33] and provides further evidence suggesting that future research in this area should consider variations by child's gender. It should be noted, however, that this is the first study to find a gender-specific association between paternal incarceration and child mortality. Having



Note. The girls were born in 1991 and were followed until age 20 years or death, whichever came first.

FIGURE 2—Survival rates for girls of incarcerated and nonincarcerated (a) fathers and (b) mothers: Denmark, 1991–2011.

a father incarcerated has been shown to be associated with substantial increases in the physical aggression of boys,[23] which are good indicators of a host of other serious behavioral and mental health problems throughout the life course.[38] Thus, those findings and our own suggest that paternal imprisonment may set boys down a destructive path that increases their risk of behaviors that may lead to an early demise. The evidence for girls suggests a different process. In the first place, girls tend to respond to the incarceration of a father with increases in internalizing behaviors rather than physical aggression. The evidence here is speculative because different data sets provide support for different conclusions.[17,18] Nonetheless, research ties paternal incarceration to other vital health changes in girls—but not boys—that suggest increases in internalizing behaviors, such as overeating.[33] Thus, although research in this area is still only speculative, indications suggest gendered behavioral trajectories in response to the incarceration of a father for boys and girls that could explain the findings we present here for paternal incarceration. As a significant proportion of the children who died did so during infancy and early childhood, however, future research also needs to examine the mechanisms linking parental incarceration to infant and early childhood mortality.

We also considered the maternal incarceration–child mortality relationship. In this area, findings were less definitive, as we expected given the often-conflicting findings in prior research on this topic.[24–26] For boys, all signs pointed toward maternal incarceration being associated with an approximate doubling in the risk of child mortality, although the relationship was not statistically significant. For girls, the results were more difficult to interpret. The coefficient for maternal incarceration tended to change course as potential confounders were included in the model and was never statistically significant, suggesting at most a weak relationship, so we temper our conclusions accordingly. Possibly even more interestingly, when we included both prior and future maternal incarceration in the model, the relationship between future maternal incarceration and child mortality totally overshadowed the relationship between prior maternal incarceration and child mortality. This suggests that the unobserved characteristics of mothers who experience incarceration, rather than the actual experience of having a mother incarcerated, probably explain any relationship between maternal incarceration and child well-being found in the earlier models.

These substantively interesting and important findings aside, this study has limitations. We focus especially on 4 limitations, the first of which has to do with the data we used. Despite their benefits,[39] registry data are limited because (1) they include only information of interest to administrative agencies (e.g., incarceration) and, as such, exclude some information (e.g., impulse control), and (2) data quality varies by how important the information is to the reporting agency, meaning some variables are measured with great precision, others with less. Beyond these limitations, our study is also limited in 3 ways. First, we could not decisively identify a causal relationship between parental incarceration and child mortality, although we provided a rigorous test. Second, although the data also included measures of the duration of incarceration, we focused only on dichotomous indicators of

paternal and maternal incarceration. Future research should also consider how the duration of paternal and maternal incarceration influences child mortality risk. Finally, this study considered this relationship in only 1 country, again suggesting the need for comparable research in a number of other different countries.

Despite these limitations, these findings call for further research that actively investigates the relationship between parental incarceration and child health and well-being. By being attentive to the gender of the incarcerated parent and any children left behind, such research could further inform our understanding of the factors that shape child health and health inequities and the public health interventions that can be used to improve them. Our research also highlights the importance of considering the role of large-scale social and economic policy as health policy.[40] A growing body of research indicates that policies unrelated to health or health care, such as education and employment policy, income support and welfare policy, and civil rights policy, have important and long-reaching impacts on health and health disparities for children and adults. It is important to begin to more fully investigate the role criminal justice policies play in shaping child health in the short and long term, as doing so can strengthen our understanding of the social determinants of child health that are most amenable to policy change. ■

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This article was accepted August 3, 2013.

Contributors

C. Wildeman designed the analysis and drafted the introduction and the Discussion section. S. H. Andersen conducted the analysis, including making all tables and figures, and provided critical revisions of the article. H. Lee provided critical revisions of the article, especially the Discussion section. K. B. Karlson provided critical revisions of the article, drafted the Results section, and aided in the analysis.

Human Participant Protection

Data analysis was approved through a long-standing agreement between the Rockwool Foundation Research Unit and Statistics Denmark. The Yale University Human Subjects Committee determined that the Yale involvement in this study did not constitute human participant research requiring review by the committee.

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