RESEARCH

Child Mortality After Hurricane Katrina

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ABSTRACT

Background: Age-specific pediatric health consequences of community disruption after Hurricane Katrina have not been analyzed. Post-Katrina vital statistics are unavailable. The objectives of this study were to validate an alternative method to estimate child mortality rates in the greater New Orleans area and compare pre-Katrina and post-Katrina mortality rates.

Methods: Pre-Katrina 2004 child mortality was estimated from death reports in the local daily newspaper and validated by comparison with pre-Katrina data from the Louisiana Department of Health. Post-Katrina child mortality rates were analyzed as a measure of health consequences.

Results: Newspaper-derived estimates of mortality rates appear to be valid except for possible underreporting of neonatal rates. Pre-Katrina and post-Katrina mortality rates were similar for all age groups except infants. Post-Katrina, a 92% decline in mortality rate occurred for neonates (<28 days), and a 57% decline in mortality rate occurred for postneonatal infants (28 days–1 year). The post-Katrina decline in infant mortality rate exceeds the pre-Katrina discrepancy between newspaper-derived and Department of Health–reported rates.

Conclusions: A declining infant mortality rate raises questions about persistent displacement of high-risk infants out of the region. Otherwise, there is no evidence of long-lasting post-Katrina excess child mortality. Further investigation of demographic changes would be of interest to local decision makers and planners for recovery after public health emergencies in other regions.

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Key Words: community disruption, disaster demographics, indirect health effects, disaster recovery, epidemiology, population displacement, resilience

Community disruption following disasters may have long-lasting consequences for health and services.[1,2] Hurricane Katrina severely disrupted the New Orleans area (Louisiana) in August 2005, and potential threats to health persist. Public health surveillance was also interrupted by the hurricane. Post-Katrina vital statistics remain unavailable from local or state government sources. Death notices in the local daily newspaper have been proposed as an alternative source of information.[3] An excess mortality rate in the New Orleans area almost a year after the hurricane[3] mainly reflected short-term factors in the adult population. However, persistent age-specific pediatric trends have not been analyzed in the post-Katrina period.

The present study was performed to validate newspaper-derived estimates of age-specific mortality rates and to identify long-lasting trends in post-Katrina child mortality rates in the greater New Orleans area. These preliminary observations may suggest hypotheses about resilience of community services and long-lasting changes in child demographics and health after major community disruption.

METHODS

The numbers of child deaths occurring during January through June 2004 (pre-Katrina) were determined from archived death notices appearing in the New Orleans daily newspaper, *The Times-Picayune*. Death notices in *The Times-Picayune* for January through July 2004 were examined via a LexisNexis Academic Search (search terms, "deaths" and "obituaries"). The numbers of child deaths occurring during January through June 2008 (post-Katrina) were identified in death notices appearing in the online obituary section of *The Times-Picayune* during January through July 2008.[4] *The Times-Picayune* death notices accurately count deaths for the entire population, mainly involving adults, in the 10-parish greater New Orleans area.[3] The greater New Orleans area includes Orleans, Jefferson, Plaquemines, Saint Bernard, Saint Charles, Saint James, Saint John the Baptist, Saint Tammany, Tangipahoa, and Washington parishes (parishes in Louisiana correspond to counties in other states).

Deaths were counted for people with ages from birth through 19 years and were categorized as follows: neonatal infants, 0 to 27 days; postneonatal infants, 28 days up to (but not including) 1 year; total for infants, 0 up to (but not including) 1 year; 1 through 4 years; 5 through 9 years; 10 through 14 years; and 15 through 19 years. Infant ages were categorized in multiple redundant ways to allow comparison with infant categories as defined in previously reported local and national data. Every pediatric age death notice was read.

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Deaths of people who resided outside the 10-parish area were excluded from analysis.

Newspaper-derived pre-Katrina and post-Katrina mortality rates for the 10-parish greater New Orleans area were calculated. The 6-month numbers of deaths were counted as described in the preceding text. The 95% confidence intervals (CIs) for the 6-month observed numbers of deaths were estimated assuming a Poisson probability distribution (age groups each had fewer than 100 deaths during the period of observation).[5] The 6-month numbers of deaths and 95% CIs were annualized by doubling them. The mortality rate was then determined by dividing the numbers of deaths by the age-specific population of the area for the respective periods.

Populations were estimated as follows: For age groups 0 through 4, 5 through 9, 10 through 14, and 15 through 19 years, populations for each of the 10 parishes in the greater New Orleans area were obtained from the US Census Bureau.[6] The July 1, 2004, populations were used as denominators for pre-Katrina rates. The July 1, 2007, populations were used as denominators for 2008 post-Katrina rates. For infants, the population was expressed as numbers of annual live births. Pre-Katrina annual live births were obtained from the most recent available 10-parish reports in 2004.[7] To estimate post-Katrina live births, 2004 live births were corrected by a factor, assuming the same rate of decline in births as the decline in each parish's 2004 to 2007 population in the age category 0 through 4 years, as reported by the US Census.[6] Finally, to estimate population in the 1- through 4-year age category, numbers of annual live births (approximately the same as the population younger than 1 year) were subtracted from the 0- through 4-year populations[6] for the pre-Katrina and post-Katrina periods.

Pre-Katrina age-specific mortality rates estimated from newspaper death notices were validated by comparison with reports for the same parishes during 2004, obtained from the Louisiana Department of Health.[7] When small numbers of deaths (ie, 1-4) occurred in a parish for an age category, the state withheld data to preserve confidentiality. Therefore, lower and upper limits of numbers of deaths per parish were assumed as 1 and 4 deaths respectively, for any withheld data from each parish.

The following comparisons were analyzed. For validation of mortality rates derived from newspaper death notices, the pre-Katrina newspaper-derived rates were compared with the last available pre-Katrina rates reported by the Louisiana Department of Health. Because local data do not express infant deaths separately for neonatal and postneonatal subgroups, national average rates were also examined for comparison.[8] Statistical comparison of newspaper-derived and Louisiana Department of Health-reported mortality rates was not possible because only an estimated range of mortality rates was available from government vital statistics, as described. The trend in pre-Katrina to post-Katrina mortality rates was analyzed by comparison of the newspaper-derived observations. If the 95% CIs did not overlap, the difference was considered to be statistically significant at the 95% confidence level.

This study was regarded as exempt from review by the SUNY Upstate Medical University (Syracuse, New York) Institutional Review Board for the Protection of Human Subjects. Only publicly available data were analyzed and reported.

RESULTS

Validation

The pre-Katrina mortality rates in the greater New Orleans area estimated from newspaper death notices were similar to the pre-Katrina rates calculated from Louisiana Department of Health data (Table 1). For all categories of children older than 1 year, the 95% CIs overlapped with ranges reported by the Louisiana Department of Health. The only discrepancy was found for infants 0 up to 1 year, with newspaper-derived estimates (6.2 deaths/1000 live births) 43% less than the rate reported by the Louisiana Department of Health (10.8 deaths/1000 live births). Louisiana Department of Health data are not available to determine whether the discrepancy is attributable to neonatal or postneonatal subgroups. Comparisons with national averages revealed that pre-Katrina newspaper-derived neonatal mortality rates (2.5 deaths/1000 live births) were 46% less than the national average (4.6 deaths/1000 live births), whereas pre-Katrina postneonatal infant rates (3.7 deaths/1000 live births) exceeded the national average (2.3 deaths/1000 live births) by 61%.

Post-Katrina Trends

Mortality rates estimated from newspaper death reports tended to decline in the post-Katrina period for all age categories except 1 through 4 years (see Table 1). However, for children 1 year or older, all changes were statistically insignificant. For age categories of 1 year or older, post-Katrina mortality rates also remained similar to national averages.

There was a large post-Katrina decline in infant mortality rates. Compared with pre-Katrina newspaper-derived rates (2.5 deaths/1000 live births), the post-Katrina neonatal rate (0.2 deaths/1000 live births) fell by 92%, and the rate for *all* infants (1.8 deaths/1000 live births) fell by 71% (from 6.2 deaths/1000 live births); both were statistically significant declines. The postneonatal mortality rate (1.6 deaths/1000 live births) fell by 57% (from 3.7 deaths/1000 live births), a difference that did not quite reach statistical significance. The post-Katrina infant mortality rates (0.2 and 1.6 deaths/1000 live births) also were 96% and 30% less than the national averages for the neonatal (4.6 deaths/1000 live births) and postneonatal (2.3 deaths/1000 live births) subgroups, respectively.

DISCUSSION

Post-Katrina data on health consequences are not available. Death notices in *The Times-Picayune* seem to be a valid alternative source of age-specific data, with the possible exception of underreporting of the neonatal mortality rate. Local pre-

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Katrina mortality rates from the Louisiana Department of Health are similar to newspaper-derived pre-Katrina rates for all age categories 1 year or older. Although newspaper-derived infant mortality may be underreported, local pre-Katrina government reports do not allow independent validation of neonatal and postneonatal subgroups. Comparison with national vital statistics reveals that the pre-Katrina newspaper-derived postneonatal infant mortality rate *exceeded* the national average, which is not suggestive of underreporting. The newspaper-derived local neonatal mortality rate was well below the neonatal national average, consistent with underreporting for this subgroup.

Newspaper-derived observations show large post-Katrina reductions in the infant mortality rate in the greater New Orleans area. Although neonatal deaths may be underreported in newspaper notices, the post-Katrina decline in infant mortality rates exceeded the discrepancy between pre-Katrina newspaper-derived and pre-Katrina Louisiana Department of Health–reported rates. Thus, the decline in the mortality rate is probably not entirely attributable to underreporting.

The substantial reduction in the post-Katrina infant mortality rate may be related to population demographic shifts, with fewer high-risk people residing in the area. The hurricane- and flood-related population displacement was the largest in US history.[9] Community disruption persists, and population displacement out of the region may be especially persistent for low-income families.[10-12] A reduction in the low-income population may account, in part, for a reduction in numbers of people vulnerable to severe health problems. A decline in services also may have forced people with high-risk conditions to leave the area. Of 39 hospitals serving Orleans, Jefferson, and St Bernard parishes before Hurricane Katrina, only 26 had reopened by February 2008.[11] A reduced workforce of health care providers may limit access to primary care and subspecialty ambulatory care.[13] Therefore, high-risk perinatal patients or infants with chronic health conditions may have disproportionately left the region for better access to specialized services elsewhere, whatever their socioeconomic status. Investigation of demographic characteristics of the population is beyond the scope of the present study. Other interpretations of declining infant mortality rates, such as improvements in post-Katrina health care, are counterintuitive.

Otherwise, the present report does not provide evidence for post-Katrina excess child mortality in the greater New Orleans area. Community services may be adequate, even if they are not optimal. On the other hand, health may be impaired, but in a way that does not cause excess deaths. Excess mortality may occur in high-risk areas, but the changes may be too small to detect on the basis of available regional data. Data available for the present report do not allow analysis of smaller geographical areas.

In addition to possible underreporting of neonatal deaths, the following potential limitations must be considered. Population estimates may be erroneous, especially the recent live birth rate,

TABLE 1

Greater New Orleans Area (Louisiana) Pediatric Deaths, Population, and Mortality Rates[a]

	Age Categories						
	0-27 d	28 d–<1 y	0-<1 y	1-4 y	5-9 y	10-14 y	15-19 y
No. of deaths							
Pre-Katrina 2004[b]							
12-mo estimated range	NA	NA	230-233	21-36	17-32	27-45	139-145
Pre-Katrina January-June 2004[c]							
6-mo Count, observed (95% CI)	27 (18-39)	39 (28-53)	66 (51-84)	11 (5-20)	7 (3-14)	12 (6-21)	61 (47-78)
Post-Katrina January-June 2008[c]							
6-mo Count, observed (95% CI)	2 (0-7)	14 (8-23)	16 (9-26)	10 (5-18)	4 (1-10)	5 (2-12)	40 (29-54)
Population[d]							
Pre-Katrina 2004	21 350	21 350	21 350	83 182	101 251	110 767	110 313
Post-Katrina 2007 (estimate for 2008)	17 743	17 743	17 743	69 056	80 244	84 931	90 145
Mortality rate[e]							
National average 2005[9]	4.6	2.3	NA	29	15	18	65
Pre-Katrina 2004[b]	NA	NA	10.8-10.9	25-43	17-32	24-41	126-131
Pre-Katrina 2004[c]							
Annualized (95% CI)	2.5 (1.7-3.7)	3.7 (2.6-5.0)	6.2 (4.8-7.9)	26 (13-47)	14 (6-28)	22 (11-38)	111 (85-142)
Post-Katrina 2008[c]							
Annualized (95% CI)	0.2 (0-0.8)f	1.6 (0.9-2.7)	1.8 (1.0-2.9)f	29 (14-53)	10 (3-26)	12 (4-27)	89 (63-121)

Abbreviations: CI, confidence interval; NA, not available.
[a]The greater New Orleans area is a 10-parish (county) region. See the text for parishes and sources of data.
[b]From the Louisiana Department of Health. See the text for an explanation of the upper and lower limits of pre-Katrina deaths in the Greater New Orleans area.
[c]From *The Times-Picayune* newspaper death notices.
[d]Population expressed as annual live births for categories younger than 1 year and as actual population for older groups.
[e]Mortality rate expressed per 1000 live births for categories younger than 1 year and per 100 000 population for older groups.
[f]Difference between pre-Katrina and post-Katrina mortality rates is statistically significant at a 95% confidence level.

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for which no independent confirmatory evidence or validated method exists to support the assumptions used in this study. The actual 2008 population at all ages may exceed the July 2007 estimates, although population recovery was slowing in 2007. If the population has been underestimated, then the per population mortality rates may actually be slightly lower than reported.

CONCLUSIONS

A declining infant mortality rate raises questions about persistent displacement of high-risk infants out of the region. Otherwise, there is no evidence of long-lasting post-Katrina excess child mortality. Further investigation of demographic changes would be of interest to local decision makers and planners for recovery after public health emergencies in other regions.

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