

## Post-Katrina New Orleans Adjustment to Control Totals for the National Immunization Survey

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### Abstract

Survey weights are used to correct for differential selection probabilities, survey non-response, and other differences among the survey participants. The final step in creating the survey weights, often called post-stratification, is to adjust them so that sums of the weights are consistent with known population totals or estimates. The National Immunization Survey (NIS) uses birth certificate data to build the best population estimates, which are then used as “control” totals for the survey weights. However, migration due to Hurricane Katrina reduced the population in the Gulf Coast between the time of the birth certificate data and the survey. This paper describes our procedures for adjusting our population estimates.

KEY WORDS: Hurricane Katrina, Post-Stratification, Orleans Parish

### 1. Introduction

The National Immunization Survey (NIS) is sponsored by the Centers for Disease Control and Prevention to measure vaccination coverage nationally, by state, and for some sub-state local areas. The NIS collects immunization information for children 19 to 35 months old. The NIS is a stratified random-digit-dial (RDD) study in which separate samples are obtained for states or sub-state local areas. Interviews are obtained via telephone. In order to allow unbiased analyses of the data collected, survey weights are created. The final step of weighting adjusts the weights so that various sums of the weights are equal to our best population estimates. These estimates are used as control totals for the weights in a process called post-stratification. The NIS uses birth cohort data from the National Center for Health Statistics (NCHS) Vital Statistics Program (which is built from birth certificates) to estimate the population. This paper describes how we adjusted control totals built from birth records from before Hurricane Katrina to correctly represent the population after Hurricane Katrina.

Section 2 explains further the rationale for determining the population size for post-stratification control totals from birth data rather than Census tabulations. Section 3 describes why the devastation in the Gulf Coast region following Hurricane Katrina renders the post-stratification totals inaccurate, as the birth data were recorded prior to Hurricane Katrina while the population represented is post-Katrina. An extra step is added to the production of post-stratification control totals to migrate some of the Orleans Parish (equivalent to the city of New Orleans) population to the rest of the country. Section 3 also describes how we estimated the out-migration from Orleans Parish. Section 4 describes how we allocated the migrants to our state and local areas for the rest of the U.S. Section 5 finishes with a summary and some conclusions.

### 2. NIS Post-Stratification Control Totals

The challenges of estimating the NIS population (so that the weights total to the population size) were two-fold. First, the targeted age group (19-35 months) spanned only 17 months. Second, we needed to have population totals for areas as small as one city or one county. However, 2000 Decennial Census data were only available for single years, and it seemed incorrect to use it to represent children who were not born until 2002 or 2003. Another potential resource – the Current Population Survey – was not large enough to cover such a small age group in so many local areas. We instead built our population estimates from NCHS Vital Statistics Natality Data collected from birth certificates.

It is important to note here that we estimated the population for three race/ethnicity groups: Hispanics, non-Hispanic Blacks, and All Others (including non-Hispanic Whites, Asians, Native Americans, and persons reporting multiple races). Additionally, we note that for the purposes of these estimates, we divided Louisiana into two parts: Orleans Parish and the “rest of Louisiana”.

We followed four steps in building the population estimates for use in weighting post-stratification. We

started by counting the births for each state and local area using the NCHS Vital Statistics Natality Data. We then adjusted for infant mortality using state-level data (by race/ethnicity) available from NCHS (Mathews et al., 2004). Third, we used Census Public-Use Microdata Samples (PUMS) data to adjust for foreign immigration. We also used PUMS data in the fourth step in adjusting for migration between the states (between birth and eligibility). More details on these steps are available upon request.

### 3. Estimating the Migration

Under normal circumstances, the above four steps would result in the final post-stratification totals. However, Hurricane Katrina's devastation of the Gulf Coast region disrupts this estimation system. The data delivery of NIS data is a bi-annual process (twice a year). For the data delivery spanning both 2005 and 2006 (the third and fourth quarters of 2005 and the first and second quarters of 2006), we used January 1, 2006 as the reference date for population estimates. We used births from 2002 and 2003 to estimate the size of the population of 19-35 month old children on January 1, 2006. These births occurred prior to Katrina, but the estimated population is post-Katrina (as the hurricane struck Louisiana in August 2005).

Since it was clear that the Gulf Coast population had been severely reduced by migration due to Hurricane Katrina, it seemed desirable to adjust the population control totals for this event. We performed this adjustment in two steps. First, we determined how many children should be migrated and from which parts of the Gulf Coast. Second, we determined where to move these migrated children.

To study the effects of the Gulf Coast population drop, we used special Census Bureau information collected as of January 1, 2006. Table 1 shows that, in the second half of 2005, Orleans Parish lost 63.8 percent of its population, declining from 437,186 on July 1, 2005 to 158,353 on January 1, 2006. (St. Bernard Parish was actually the hardest hit parish, losing almost 95 percent of its population, but Orleans Parish is the only sub-state local area in Louisiana; data for St. Bernard were merged with the Rest of the State of Louisiana, which lost only 2.3 percent of its total population.) When compared to the sizable post-Katrina migration in Orleans Parish, other states in the area showed only small effects: Alabama and Mississippi had small losses, while Texas showed a gain (one of the primary destinations for Katrina refugees was Houston). Since the changes for the Rest of the State of Louisiana and other states were small,

we limited our downward adjustment to Orleans Parish.

The 2006 Louisiana Health and Population Survey (LHPS) estimated additional post-Katrina population figures for subgroups. In particular, it contained estimates for children under five years old and by race/ethnicity. One limitation to the LHPS numbers was that the time period of the survey was October 17-26, 2006. Between the reference date for our population estimates (January 1, 2006) and the LHPS time period, some people have clearly returned. In fact, Tables 2 and 3 show that the Orleans Parish population grew by about 33,000 people between January 1, 2006 and October, 2006.

Table 2 shows the available race/ethnicity breakdowns that came closest to those used for the NIS. For Hispanic origin, the best we were able to obtain was Census 2000 estimates. For race, we were also able to obtain some Census Bureau percentages from 2004, which we applied to the Census July 1, 2005 estimates. (The total estimates for Orleans Parish are shown for comparison.) The "White only" category includes most Hispanics since race and ethnicity data were collected separately. Table 2 shows that the drop in population was concentrated among the non-Hispanic Black and White populations. Based on this information, we migrated two-thirds of the non-Hispanic Black population and one-third of the All Others population from Orleans Parish, leaving the Hispanic population totals unchanged.

While Table 2 shows race/ethnicity breakdowns, Table 3 shows population estimates for the population under five years old. The LHPS reported a drop of nearly 77 percent of the children under five in Orleans Parish between Census 2000 and the LHPS, which is even greater than the overall percentage across all ages (60.6 percent). We have taken this as evidence that our decision to migrate two-thirds of the non-Hispanic Blacks and one-third of the All Others population may have been conservative.

The post-stratification totals for Orleans Parish prior to this special migration step were: 223 Hispanics, 7,384 Non-Hispanic Black, and 1,990 Non-Hispanic Non-Blacks, for a total of 9,598. Our decision, then, was to move 4,923 ( $2/3 * 7,384$ ) non-Hispanic Blacks and 663 ( $1/3 * 1,990$ ) All Others from Orleans Parish.

### 4. Dispersing the Migrants

At this point in the process, we had determined how many children to migrate, but still needed to decide upon new locations to which they should be moved.

To aid in this decision, we used a Federal Emergency Management Agency summary of a list of the reported mailing addresses of Katrina aid applicants. Table 4 shows the top fifteen metropolitan areas in terms of Katrina aid applicants.

We mapped the metropolitan areas given to our state and local areas. Ten of the top fifteen metropolitan areas were located in Katrina-affected areas (Louisiana, Mississippi, and Mobile, Alabama), and we considered applicants in these areas to be primarily non-migrants (Table 4 includes a column that identifies which of these top fifteen will receive migrants; the rest are affected areas). Even though some people moved from New Orleans to other parts of Louisiana, Louisiana population size declined outside of Orleans Parish, so we did not allow them to gain any migrants. We applied the same logic to Mississippi and Mobile, Alabama (see Table 1). Table 4 shows that we eliminated ten of the top fifteen areas in aid applicants, leaving Houston, Dallas, Atlanta, Memphis, and San Antonio.

Eliminating the Louisiana, Mississippi, and Mobile, Alabama areas left us with 293,844 applicants (out of 1,288,365 total applicants). We divided these applicants among the state and local areas. Table 5 shows the top ten NIS state and local areas in Katrina aid applicants. Included in the table are the number of applicants, the percentage of applicants (and migrants gained), and the migrants gained by the two race/ethnicity categories for each of these ten areas. These ten areas account for 69.4 percent of the applicants. The remaining five metropolitan areas (not eliminated) from Table 4 are in the top eight in Table 5 along with the 'rest of state' areas for Texas, Florida, and Alabama.

We assigned the migrants to our state and local areas proportionally to the number of applicants. Since we didn't have any race/ethnicity data on the aid applicants, we had to assume that each area received the same proportion of non-Hispanic Blacks and non-Hispanic non-Blacks. Since 88.1 percent of the migrants are non-Hispanic Black, areas that receive migrants are assumed to receive 88.1 percent non-Hispanic Black migrants. For example: Houston, TX had 74,977 applicants. Since this is 25.5 percent of the applicants, we moved 25.5 percent of the migrants to Houston ( $.255 * 4,923 = 1,256$  non-Hispanic Blacks and  $.255 * 663 = 169$  non-Hispanic non-Blacks). Note that Houston receives 1,424 migrants, and 88.1 percent (1,256) are non-Hispanic Black. Every cell received a proportionate amount of these migrants. Since Houston already had 12,850 non-Hispanic Blacks and 14,560 non-Hispanic non-Blacks, every

non-Hispanic Black cell total was multiplied by 1.098  $[(12,850 + 1,256)/12,850]$ , and every non-Hispanic non-Black cell total was multiplied by 1.012  $[(14,560 + 169)/14,560]$ . Via this process, we increased Houston's non-Hispanic Black population by 9.8 percent and their All Other population by 1.2 percent.

Table 6 shows the ten areas with the largest percentage increases in non-Hispanic Blacks (also included are the figures for Orleans Parish for comparison). This table reveals that the migrants added make a significant impact for many of the state and local areas, although the percentage increases are much greater for non-Hispanic Blacks than non-Hispanic non-Blacks. This disparity is not surprising as seven times as many non-Hispanic Blacks migrated from Orleans Parish. In all, there were sixteen areas with an increase of at least one percent in non-Hispanic Black population, but only one (Houston) with a similar increase among non-Hispanic non-Blacks.

Another effect is that some states that received only a small number of migrants still had a large percentage increase in non-Hispanic Blacks. The best example is northern New Mexico, which had 578 (0.20 percent) aid applicants, yielding 10 non-Hispanic Black migrants and one All Other migrant. This migration adds 2.7 percent to the 356 non-Hispanic Blacks already in northern New Mexico. Even if the right number of migrants to northern New Mexico is 11, it seems unsatisfactory to assume that 10 (roughly 88.1 percent) of them are non-Hispanic Black. A second, less troublesome example is Montana, which had 75 (0.03 percent) of the aid applicants, yielding one non-Hispanic Black migrant (0 non-Hispanic non-Black migrants); as a result, the previous population of 68 non-Hispanic Blacks increased by 1.8 percent.

## 5. Summary

We wanted to estimate the population of 19-35 month olds in NIS state and local areas. Census data were not local or specific enough for these localities. Fortunately, birth cohort data from the NCHS provided us with the ability to estimate our target population. Hurricane Katrina's devastation, however, caused our estimates to be inaccurate for New Orleans and required an innovative approach that used special Census and Louisiana Health and Population survey data to estimate the out-migration.

These data did not represent a perfect solution, however. In our case, the Katrina aid recipient list was not broken down by race/ethnicity. Thus, we made the most reasonable assumption possible: that the race/ethnicity proportion of the applicants was the

same in each area. The proportion used was 88.1 percent non-Hispanic Black; slight distortions could have resulted if the people displaced to these locations were greater or less than 88.1 percent non-Hispanic Black.

As a final summary of the Katrina migration among 19-35 months old, two-thirds of the non-Hispanic Blacks and one-third of the non-Hispanic non-Blacks left Orleans Parish. The largest numbers settled in Houston, increasing the non-Hispanic Black population by 9.8 percent and the non-Hispanic non-Black population by more than one percent. Out of

the NIS state and local areas, sixteen increased their non-Hispanic Black population by more than one percent, but only Houston increased its non-Hispanic non-Black population by more than one percent.

#### References

Mathews, T.J., Menacker, F., and MacDorman, M. F. (2004). Infant Mortality Statistics from the 2002 Period Linked Birth/Infant Death Data Set. National Vital Statistics Reports. Vol 53, Number 10. Hyattsville, MD: National Center for Health Statistics.

Section on Survey Research Methods

Table 1. Census Bureau Estimated Population Totals for Gulf Coast Areas.

<i>Area</i>	<i>Population, July 1, 2005</i>	<i>Population, January 1, 2006</i>	<i>Gain or Loss</i>
Orleans Parish	437,186	158,353	-278,833 (-63.8%)
Rest of State, Louisiana	2,893,414	2,827,466	- 65,948 (- 2.3%)
Louisiana, total	3,330,600	2,985,819	-344,781 (-10.4%)
<i>Other Selected Parishes</i>			
St. Bernard Parish	64,576	3,361	- 61,215 (-94.8%)
Plaquemines Parish	28,282	20,164	- 8,118 (-28.7%)
Cameron Parish	9,493	7,532	- 1,961 (-20.7%)
<i>Other States</i>			
Alabama	855,874	855,681	- 193 (- 0.0%)
Mississippi	1,882,198	1,839,808	- 42,390 (- 2.2%)
Texas	5,859,568	5,996,455	+136,877 (+2.3%)

Source: [http://www.census.gov/Press-Release/www/emergencies/gulfcoast\\_impact\\_estimates.xls](http://www.census.gov/Press-Release/www/emergencies/gulfcoast_impact_estimates.xls)

Table 2. Estimated Race/Ethnicity Population Totals from the 2006 LHPS.

<i>Subgroup</i>	<i>Census 2000</i>	<i>Census July 1, 2005 (also uses 2004)</i>	<i>LHPS October, 2006</i>	<i>LHPS gain/loss (Census 2000)</i>	<i>LHPS loss (Census 2004)</i>
TOTAL Orleans	484,674	437,186	191,139	-60.6%	-56.4%
White only*	135,956	125,035	81,557	-40.0%	-34.8%
Black only	325,947	296,412	89,891	-72.4%	-69.7%
Other	22,771	15,738	19,691	-13.5%	+25.1%
Hispanic	15,510	n/a	18,303	+18.0%	n/a
Non-Hispanic	469,164	n/a	164,722	-64.9%	n/a
Unknown	0	n/a	8,114	n/a	n/a

\* Most Hispanics are included in the White only category, but the number of Hispanics is small.

Source: [http://popest.org/popestla2006/files/Popest\\_Orleans\\_SurveyReport\\_112706.pdf](http://popest.org/popestla2006/files/Popest_Orleans_SurveyReport_112706.pdf).

Table 3. Estimated Overall and Under 5 Population Totals from the 2006 LHPS.

<i>Subgroup</i>	<i>Census 2000</i>	<i>Census July 1, 2005</i>	<i>Census January 1, 2006</i>	<i>LHPS October, 2006</i>	<i>LHPS loss (Census 2000)</i>	<i>LHPS loss from July 1, 2005</i>
TOTAL Orleans	484,674	437,186	158,353	191,139	-60.6%	-56.4%
Under 5 yrs	33,496	n/a	n/a	7,846	-76.6%	n/a

Source: [http://popest.org/popestla2006/files/Popest\\_Orleans\\_SurveyReport\\_112706.pdf](http://popest.org/popestla2006/files/Popest_Orleans_SurveyReport_112706.pdf).

Table 4. Top 15 Metropolitan Areas in Katrina Aid Applicants

<i>Ranking</i>	<i>CBSA</i>	<i>Metropolitan Statistical Area Name</i>	<i>State</i>	<i>Number of Applicants</i>	<i>Will Receive Migrants?</i>
1	35380	New Orleans-Metairie-Kenner, LA	LA	392,687	No
2	12940	Baton Rouge, LA	LA	158,742	No
3	25060	Gulfport-Biloxi, MS	MS	97,026	No
4	33660	Mobile, AL	AL	83,958	No
5	27140	Jackson, MS	MS	81,314	No
6	26420	Houston-Baytown-Sugar Land, TX	TX	70,401	<b>YES</b>
7	37700	Pascagoula, MS	MS	59,036	No
8	25620	Hattiesburg, MS	MS	49,573	No
9	26380	Houma-Bayou Cane-Thibodaux, LA	LA	47,881	No
10	19100	Dallas-Fort Worth-Arlington, TX	TX	32,768	<b>YES</b>
11	12060	Atlanta-Sandy Springs-Marietta, GA	GA	26,604	<b>YES</b>
12	29180	Lafayette, LA	LA	15,205	No
13	32820	Memphis, TN-MS-AR	TN	7,556	<b>YES</b>
14	43340	Shreveport-Bossier City, LA	LA	6,831	No
15	41700	San Antonio, TX	TX	6,719	<b>YES</b>

Source: [http://www.fema.gov/pdf/hazard/hurricane/2005katrina/metro\\_stats.pdf](http://www.fema.gov/pdf/hazard/hurricane/2005katrina/metro_stats.pdf)

Table 5. Top Ten NIS State and Local Areas in Aid Applicants (and Migrants).

<i>Ranking</i>	<i>State or Local Area</i>	<i>Number of Applicants</i>	<i>Percent of Applicants</i>	<i>Non-Hispanic Blacks Added</i>	<i>Non-Hispanic non-Blacks Added</i>
1	Texas- City of Houston	74,977	25.52%	1,256	169
2	Texas- Dallas County	33,832	11.51%	567	76
3	Georgia- Fulton/DeKalb Co.	27,298	9.29%	457	62
4	Texas- rest of state	16,450	5.60%	276	37
5	Florida - rest of state	16,332	5.56%	274	37
6	Alabama- rest of state	8,845	3.01%	148	20
7	Tennessee- Shelby County	7,775	2.65%	130	18
8	Texas- Bexar County	7,003	2.38%	117	16
9	Arkansas	5,671	1.93%	95	13
10	California- Los Angeles Co.	5,583	1.90%	94	13

Table 6. Top Ten NIS State and Local Areas with Largest Percentage Increases.

<i>Ranking</i>	<i>State or Local Area</i>	<i>Increase for non-Hispanic Blacks</i>	<i>Increase for non-Hispanic non-Blacks</i>
1	Texas- City of Houston	9.8%	1.2%
2	Texas- Bexar County	5.8%	0.2%
3	Texas- Dallas County	5.0%	0.4%
4	Georgia- Fulton and DeKalb counties	2.8%	0.5%
5	New Mexico – Northern New Mexico	2.7%	0.0%
6	Texas- El Paso County	2.3%	0.1%
7	Colorado- rest of state	1.9%	0.0%
8	Montana	1.8%	0.0%
9	Utah	1.5%	0.0%
10	Tennessee- Shelby County	1.4%	0.2%
...	...		
Last	Louisiana- Orleans Parish	-66.7%	-33.3%