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Effectiveness of a Federal Healthy Start Program in Reducing Infant Mortality

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Abstract

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Method: We conducted a five-year (2010-2014) trends analysis using birth and infant death data extracted from the Florida Community Health Assessment Resource Tool Set (CHARTS). The number of infant deaths and live births were used to calculate and compare IMRs in the CHHS catchment area to those in the rest of Hillsborough County, and the state of Florida. Three-year centered moving averages were directly adjusted to account for differences in the racial/ethnic distribution of mothers across geographic areas.

Results: Between 2010 and 2014, the IMR decreased 42.8% in the CHHS service area (from 14.5 to 8.3 per 1,000 live births) compared to decreases of 10.1% and 7.7% in the rest of Hillsborough County and the state of Florida, respectively. Additionally, the infant mortality gap in the CHHS catchment area narrowed from 72% in 2010 to 14% in 2014 compared to the rest of the state, and was eliminated when compared to the rest of Hillsborough County.

Discussion: The absolute and relative decreases in IMR in the CHHS catchment area reflect the program's effectiveness in decreasing disparity in infant mortality. The quality services provided by the CHHS program have had a significant positive impact on the families served.

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Keywords: Infant Mortality, Healthy Start, Community-Focused Intervention, Program Effectiveness

INTRODUCTION

Infant mortality is a devastating outcome and an important indicator of societal quality of life (Willis, McManus, Magallanes, Johnson, & Majnik, 2014). Despite spending significantly more on healthcare than any other nation in the world, the United States (U.S.) has a higher infant mortality rate (IMR) than most industrialized countries (U.S. Department of Health and Human Services, 2014). According to the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics there were 23,440 infant deaths in the U.S. in 2013 resulting in an IMR of 6 per 1,000 live births (National Center for Health Statistics, 2016). Perhaps even more alarming are the persistent racial and ethnic disparities observed across adverse birth outcomes, including but not limited to infant deaths. IMRs are disproportionately higher among African Americans than their non-Hispanic White counterparts, with rates 2-3 fold higher in many communities (Alio et al., 2010; Salihu et al., 2011). These trends have persisted for decades, particularly in underserved communities (Willis et al., 2014).

In response to these persistent racial/ethnic disparities, the Healthy Start (HS) program was initiated in 1991 by the Health Resources and Services Administration (HRSA) to address the alarmingly high IMRs in socioeconomically disadvantaged communities throughout the nation. Since its inception, the HS program has remained focused on the goal of reducing infant deaths through the direct provision of services and meaningful interagency collaborations that are designed to enhance collective impact. The Central Hillsborough Healthy Start (CHHS) in Tampa, Florida is one HS program funded by the federal government through HRSA's Maternal and Child Health Bureau Healthy Start Initiative. CHHS was born out of the University of South Florida in 1998 but has been managed by REACHUP, Inc., a 501(c)(3) non-profit, community-based organization which has been providing family-centered preconception, prenatal, and interconception risk reduction services to underserved communities in the Tampa Bay region since 2009. In Florida, all pregnant women and infants born in hospitals or birthing centers are offered risk screens to identify those who would benefit most from early intervention and coordinated care. The prenatal risk screen collects information on maternal socio-demographics such as age, race/ethnicity, education, and marital status. In addition, women are asked about high-risk behaviors such as tobacco and alcohol use during pregnancy. Regardless of the results of the risk screen, any pregnant woman may enroll in the CHHS program if she chooses; however, the nature and intensity of services provided are tailored to each client's level of risk for adverse pregnancy or birth outcomes. Participation in the CHHS program is voluntary and all services are provided to participants free of charge

REACHUP, Inc. is funded by HRSA to provide risk reduction services to women, infants and children whose permanent residence lies within a four zip code area in East Tampa. Each year, CHHS serves more than 2,000 predominantly African-American individuals and families in its catchment area. The services provided are comprehensive and include a range of integrated activities from health education to care coordination. Women who accept HS services are assigned a case manager. The case manager contacts the HS client to evaluate and triage participant concerns related to the current pregnancy and to determine whether there is a need for further services or other resources. During home visits, the case manager also conducts a professional needs assessment focusing primarily on the participant's health status and any potential social–environmental risks. Depending on the needs of the participant, care coordination could include referrals to the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), smoking cessation referrals and follow-up, mental health/depression counseling provided by a licensed practitioner, and in extreme circumstances

relocation to safer environments. The HS client and the case manager work together to devise a comprehensive plan for promoting a healthy pregnancy, delivery, and a "healthy start".

HS services provided by REACHUP, Inc. also encompass the screening and enrollment of newborn infants. Newborn risk screens assess complications at delivery (e.g., neonatal intensive care unit [NICU] admission, receipt of surfactant replacement therapy), adverse birth outcomes (e.g., birthweight less than 2000 grams), and maternal risk factors such as age, number of prenatal visits, or the use of tobacco during pregnancy. Additionally, the infant risk screen collects information to determine father involvement during pregnancy (i.e., father's name not present or unknown). Similar to the prenatal clients, any infant may be enrolled in the HS program regardless of the screen results, but service provision and care coordination will be driven by the level of risk. On average, CHHS enrolls more than 500 infants into the HS program annually, which represents more than 50% of the infants born in the catchment area. Infant participants typically receive HS services for up to two years. In many instances, the mother will receive interconception care services while the infant receives newborn care services. The primary goal of the services is to reduce infant mortality in the socioeconomically disadvantaged area.

In this analysis, we sought to evaluate whether temporal changes in IMRs were different between maternal-infant dyads living within the CHHS program service area in Tampa, Florida and those residing in Florida but without access to CHHS services. Using an ecological analytic framework, we assessed the impact of the CHHS Federal Healthy Start program on: (1) trends in infant mortality within the CHHS service zip codes; and (2) disparities in IMRs between the CHHS service area and two county and state-based geographic regions. We hypothesized that as a result of the Federal Healthy Start intervention program, the CHHS program service area would experience a more pronounced decrease in IMR than in other areas of the county and state not served by CHHS.

METHODS

We conducted a five-year (2010-2014) ecological trends analysis using linked birth and infant death data extracted from the Florida Community Health Assessment Resource Tool Set (CHARTS). Florida CHARTS is an online, publically available resource which contains community health data and public health statistics. Data housed in Florida CHARTS are retrieved from various sources including the Florida Department of Health (FDOH), the Florida Agency for Health Care Administration, and the Florida Department of Law Enforcement. Birth and infant death records are linked by the FDOH Division of Public Health Statistics & Performance Management. For this analysis, we included all birth and infant death data for "resident" events (i.e., births and deaths occurring to Florida residents regardless of their place of occurrence). The extraction of data from Florida CHARTS ensured comparability of sociodemographic and outcome information obtained over time at the local, county, and state levels due to the consistent data collection and management protocols.

Study Variables

The primary exposure variable in this study was residence in the CHHS service area, which was defined based on documented county of residence (Hillsborough) and zip code of residence (33602, 33603, 33605, 33610). Two comparison groups were defined: (1) Hillsborough County residents who did not reside in the CHHS service area; and (2) Florida residents who did not reside in Hillsborough County. These three geographically-defined groups

were mutually exclusive; no maternal-infant dyads were counted in more than one group. For each group, in addition to infant mortality, we extracted aggregated information on sociodemographic and perinatal characteristics including maternal age (<35 years or ≥35 years), race (NH-Black vs. Other), ethnicity (Hispanic vs. non-Hispanic), education (less than high school vs. high school graduate or higher), marital status (married vs. not married), principal payer (Medicaid vs. other), prenatal care (late or no prenatal care vs. other), pre-pregnancy body mass index (<30 kg/m2 vs. ≥30 kg/m2), and tobacco use (yes vs. no). We also collected information on cesarean delivery, gestational age (<37 weeks vs. ≥37 weeks), and birth weight (<2500 grams vs. ≥2500 grams).

Statistical Analysis

Descriptive statistics including frequencies and percentages were used to compare the distribution of sociodemographic and perinatal characteristics (i.e., risk factors) and pregnancy outcomes among maternal-infant dyads in the CHHS catchment area to those in the rest of the county and the state. We calculated 95% Pearson-Clopper (exact) confidence intervals (CI) for each percentage and assessed statistically significant differences using chi-square and Fisher's exact tests. In each exposure group, the IMR was calculated as the number of deaths during the first year of life per 1,000 live births in the same calendar year. Infant mortality is a rare event and IMRs can have temporal volatility when calculated annually, particularly in smaller geographic areas. Therefore, to better assess the true underlying temporal trends in infant mortality during the study period, we smoothed the observed IMRs using three-year centered moving averages. We then compared annual trends in infant mortality among infants born to residents in the CHHS service area to those born to residents in the rest of Hillsborough County and the rest of Florida. The IMRs were then directly adjusted to account for significant differences in maternal age and racial/ethnic distribution of mothers across geographic areas, and adjusted rate ratios (RR) were used to assess whether there were changes in the CHHS infant mortality disparity gap between 2010 and 2014. SAS version 9.4 (SAS Institute, Cary, NC, USA) was used to perform all analyses. This study was approved by the Office of the Institutional Review Board at the University of South Florida.

RESULTS

During the study period, 7,739 infants were born to women in the CHHS catchment area, 74,990 in Hillsborough County (excluding CHHS catchment area), and 993,080 in the state of Florida (excluding Hillsborough County). A summary of the differences in the distribution of maternal sociodemographic characteristics often associated with increased risk of infant mortality, across the three geographic regions, is provided in Table 1. Of the births in the CHHS catchment area, 53.2% were to non-Hispanic black mothers. Nearly one-quarter (23.5%) of infants were born to mothers with less than a high school education and 70% were born to unwed women. Compared to the rest of the county and the state of Florida, births in the CHHS service area were significantly more likely to be covered by Medicaid and to occur among younger, non-Hispanic mothers.

Table 2 summarizes the frequency of risk factors and pregnancy outcomes in the CHHS service area, Hillsborough County and the state. Women in the CHHS service area were more likely to be smokers (5.3%) compared to women in the rest of the county (4.3%) but less likely to consume tobacco products during pregnancy than women in other areas of Florida (6.9%). Nearly 25% of women in the CHHS catchment area were considered obese prior to pregnancy,

Table 1: Selected socio-demographic characteristics, CHHS Catchment Area, Hillsborough County, and Florida, 2010-2014.

Characteristic	CHHS Catchment Area (N=7,739) % (95% CI)[a]	Hillsborough County (N=74,990) % (95% CI)[a]	P[b]	Florida (N=993,080) % (95% CI)*	P[c]
Maternal age					
≥ 35 years	9.4 (8.8, 10.1)	14.9 (14.7, 15.2)	<0.01	15.5 (15.5, 15.6)	<0.01
Race					
NH-Black	53.2 (52.1, 54.3)	16.6 (16.4, 16.9)	<0.01	18.4 (18.3, 18.5)	<0.01
Ethnicity					
Hispanic	17.9 (17.1, 18.8)	30.7 (30.4, 31.0)	<0.01	27.4 (27.4, 27.5)	<0.01
Education					
<High School	23.5 (22.6, 24.5)	15.8 (15.5, 16.1)	<0.01	15.0 (15.0, 15.1)	<0.01
Marital Status					
Married	29.6 (28.6, 30.7)	53.5 (53.2, 53.9)	<0.01	52.3 (52.2, 52.3)	<0.01
Delivery Payment					
Medicaid	71.0 (70.0, 72.0)	47.3 (46.9, 47.6)	<0.01	50.3 (50.2, 50.4)	<0.01

[a]Based on exact (Clopper-Pearson) confidence limits for the binomial proportion
[b]P-value calculated using a Fisher's exact test comparing the CHHS catchment area and Hillsborough County
[c]P-value calculated using a Fisher's exact test comparing the CHHS catchment area and Florida

more than either women in the rest of the county (19.1%) or state (20.8%). Mothers in the CHHS service area were also less likely to enter prenatal care late or to not receive prenatal care than mothers in other regions. Although there were no differences in cesarean delivery rates, infants born in the CHHS catchment area were more likely to be born preterm and low birth weight.

Table 2: Frequency of risk factors and pregnancy outcomes, CHHS Catchment Area, Hillsborough County, and Florida 2010-2014.

| Characteristic	CHHS Catchment Area (N=7,739) % (95% CI)[a]	Hillsborough County (N=74,990) % (95% CI)[a]	P[b]	Florida (N=993,080) % (95% CI)*	P[c]
Tobacco Use					
Yes	5.3 (4.9, 5.9)	4.3 (4.2, 4.5)	<0.01	6.9 (6.9, 7.0)	<0.01
BMI ≥ 30					
Yes	23.9 (22.9, 24.9)	19.1 (18.8, 19.4)	<0.01	20.8 (20.7, 20.9)	<0.01
Late or No Prenatal Care					
Yes	11.0 (10.3, 11.7)	10.3 (10.1, 10.5)	0.05	13.6 (13.5, 13.6)	<0.01
C-Section					
Yes	37.0 (36.0, 38.1)	36.5 (36.2, 36.9)	0.36	37.9 (37.8, 38.0)	0.14
Low Birth Weight (<2500g)					
Yes	12.5 (11.7, 13.2)	8.7 (8.5, 8.9)	<0.01	8.6 (8.6, 8.7)	<0.01
Preterm Birth (<37 weeks)					
Yes	15.5 (14.7, 16.3)	13.0 (12.7, 13.2)	<0.01	13.8 (13.7, 13.9)	<0.01

*Based on exact (Clopper-Pearson) confidence limits for the binomial proportion
[b]P-value calculated using a Fisher's exact test comparing the CHHS catchment area and Hillsborough County
[c]P-value calculated using a Fisher's exact test comparing the CHHS catchment area and Florida

In the CHHS service area, the smoothed IMR in 2010 was 14.5 per 1,000 live births, nearly twice as high as the IMR for the rest of Hillsborough County (7.9 per 1,000 live births) and more than double the IMR for the rest of the state (6.5 per 1,000 live births) (Figure 1). In all three geographic regions, the IMR decreased between 2010 and 2014. However, the most pronounced change was the 42.8% decrease in IMR within the CHHS service area (from 14.5 to 8.3 per 1,000 live births). The IMR decreased 10.1% in the rest of Hillsborough County and 7.7% in the rest of Florida.

Figure 1. Infant mortality rates in CHHS Catchment Area, Hillsborough County, and Florida, 2010-2014
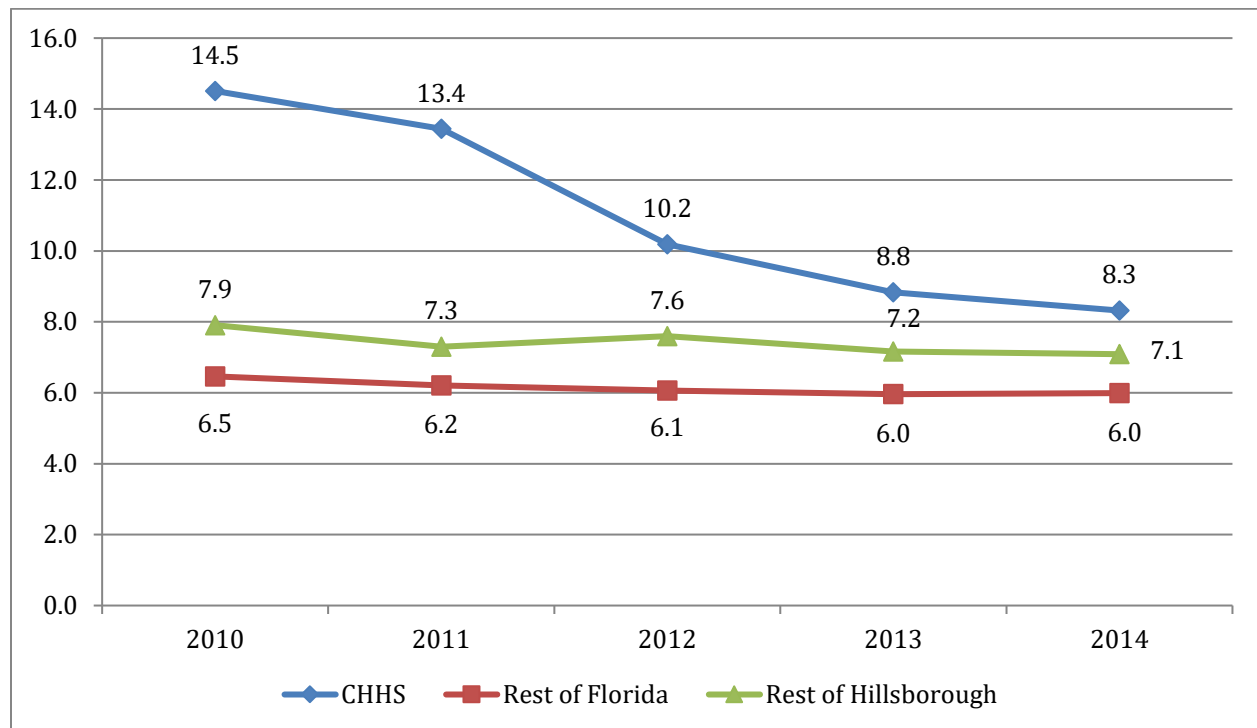
Footnote: To address temporal volatility in IMRs, three-year centered moving averages were used to smooth observed rates.

To determine the extent to which the infant mortality gap is changing in the CHHS service area after accounting for differences in the population subgroups, the three-year centered moving averages were first adjusted for maternal age and race/ethnicity. Then annual mortality RRs were used to assess the infant mortality gap. In 2010, after adjusting for differences in maternal age and racial/ethnic distribution across the three geographic areas, the IMR in the CHHS service area was 33% higher than in the rest of Hillsborough County, and 72% higher than the IMR in the rest of Florida (Figure 2). However, over the five-year study period, the infant mortality gap between the CHHS service area and the rest of the state decreased each year to a 14% increased risk of infant mortality in 2014. Additionally, the age- and race/ethnic-adjusted IMR rate in CHHS service area from 2012-14 was no different than the non-CHHS areas of Hillsborough County, reflecting an elimination of the infant mortality gap.

Figure 2. Rate ratios of 3-year centered moving average infant mortality rates adjusted for maternal age and race/ethnicity: CHHS Catchment Area vs. Hillsborough County and CHHS Catchment Area vs. Florida, 2010-2014
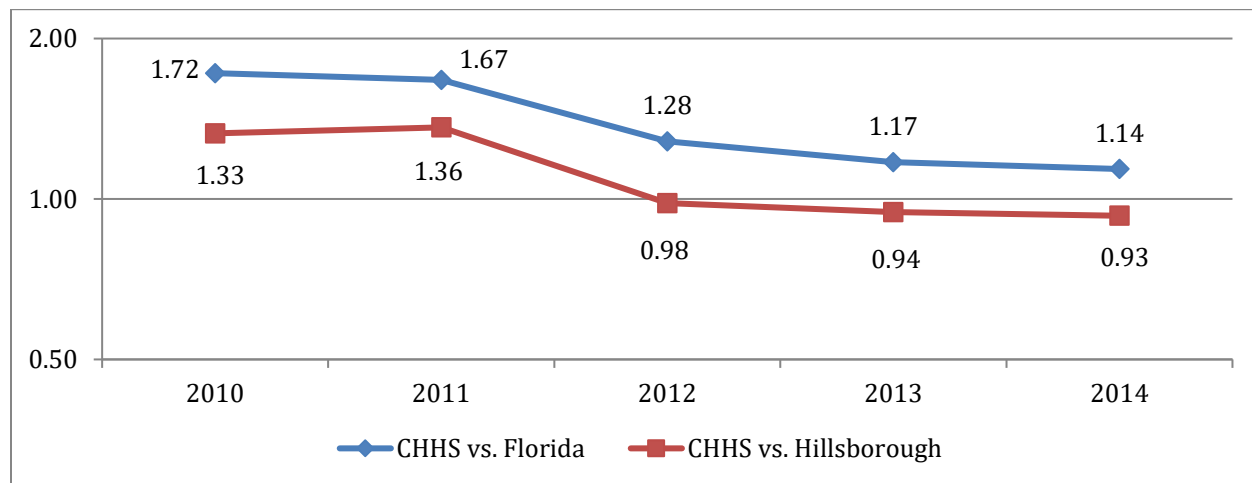
DISCUSSION

Overall, infant mortality decreased between 2010 and 2014 in all geographic regions examined (CHHS catchment area, Hillsborough County, and the state of Florida); however, the most significant reduction was identified in the CHHS program service area. This improvement was particularly notable as women in the CHHS catchment area were significantly more likely to exhibit common risk factors for adverse birth outcomes, including lower levels of education and greater body mass index (Cammu, Martens, Van Maele, & Amy, 2010; Declercq, MacDorman, Cabral, & Stotland, 2016; Salihu, 2011; Yan, 2015). Additionally, they were less likely to be married and more likely to deliver prematurely or give birth to a low birthweight infant. Despite these factors, substantial progress has been made toward reducing infant mortality in this historically underserved area of East Tampa. The absolute decrease in IMRs during the study period was also accompanied by a progressive reduction in the disparity in IMR between the CHHS service area and the rest of the state, and an elimination of the gap between CHHS and the rest of Hillsborough County.

It is highly likely that the reduction in IMRs in all three geographic regions is due to a widespread, international, and concerted effort to reduce infant mortality. The U.S. Department of Health and Human Services has a stated Healthy People 2020 objective to reduce infant mortality to 6.0 infant deaths per 1,000 live births. The Maternal and Child Health Bureau of HRSA has risen to this challenge by funding HS programs nationwide. These programs are geared toward outreach, health education, case management, and collaboration with like-minded organizations. The more pronounced decrease in infant mortality in the CHHS region is likely attributable to the comprehensive and intensive risk reduction services provided by the HS program at REACHUP. Previous evaluation studies of CHHS reported that the program reduced the risk for very low birthweight and preterm births by approximately 30% (Salihu, Mbah, Jeffers, Alio, & Berry, 2009), and obese mothers in the CHHS program have a 61% lower likelihood of very preterm delivery (August et al., 2015).

The use of a statewide data collection and reporting system lends many strengths to this study. All data were captured in a consistent manner, which ensures data comparability and minimizes the likelihood of selection bias or differential misclassification. To address temporal volatility in IMRs, three-year centered moving averages were used to smooth observed rates. Direct standardization was then used to assess changes in the CHHS infant mortality disparity gap between 2010 and 2014 while accounting for the younger maternal population and the differences in racial/ethnic distribution in the CHHS catchment area. Consequentially, even after adjusting for these confounders, the infant mortality gap between CHHS and the rest of the county was eliminated and the gap between CHHS and the state of Florida was reduced substantially.

Lack of access to individual-level vital statistics data restricted our ability to compare infant mortality rates for the comparison groups to the IMRs among the actual maternal-infant dyads who received CHHS program services. Instead, a community-level analysis of residents of the service area served as a proxy for assessing the impact of the program. The findings of this study remain reassuring despite this limitation as more than 50% of infants born in the catchment area each year receive Healthy Start services. The limitation related to the inability of this analysis to identify the specific services or interventions that were the most instrumental in reducing the IMR in the CHHS service area is mitigated by the fact that it is highly likely multiple factors contributed to the reduction in mortality. Additionally, much of the success of the Healthy Start program could be attributed to the effective coordination of needed referrals and resources for program participants. CHHS serves as a central hub or backbone entity for many community initiatives and stakeholders, therefore it is plausible that the services provided by CHHS have fostered a positive collective impact which extends beyond those program participants who directly received services.

CONCLUSION

This study demonstrates the effectiveness of the federal Healthy Start program in closing the gap in infant mortality rates in a historically underserved population. The public health implications of these findings are considerable given the significance of infant mortality and the global initiatives to reduce the rates. The absolute and relative decreases in IMRs in the CHHS catchment area reflect the program's life-saving potential and demonstrate that early and intensive risk-reduction services provided by the CHHS program have had a significant positive impact on the families and the community served.

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