INFANT MORTALITY TREND ANALYSIS, Kalamazoo County, 2010-2015 - UPDATED
Kalamazoo County Healthy Babies-Healthy Start - August, 2016

PROJECT NAME: Kalamazoo County Healthy Babies-Healthy Start

TITLE OF REPORT: Infant Mortality Trend Analysis, Kalamazoo County, 2010-2015 – UPDATED*

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*This report has been updated by recoding "undetermined" SUID cases as "sleep-related," after consultation with Lindsay Gross, National Sudden Unexpected Infant Death Registry

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Section I: Introduction

Within Kalamazoo County the overall infant mortality rate (IMR) has dropped precipitously over the last decade, from 10.2 (per 1,000 births) during the 2001-2003 period to 6.0 (per live births) during the 2011-2013 period. However during this same period, the racial disparity between White and Black infant deaths has grown: from a Black-White ratio of 2.3 during the 2001-2003 period (19.5 Black IMR and 8.4 White IMR) to a ratio of 4.0 during the 2011-2013 period (15.5 Black IMR and 3.9 White IMR). This disparity is nearly double the nation's Black-White ratio of 2.2 and the state of Michigan's ratio of 2.3 (in 2013).[1][2]

The social determinants of health theory, adopted by health agencies across the globe, understands racial inequity as the end result of social institutions that systematically disadvantage people of color, particularly those of Black race.[3][4][5] Within this framework, social exclusion from economic participation and power is a major vehicle for institutionalized racism in the U.S. Poverty is experienced by 2.6 times more Blacks than Whites, extreme intergenerational poverty is more common among Blacks,[6] and racially segregated Black neighborhoods consistently have greater concentrations of poverty.[7] Living in segregated, high poverty communities further compounds the effect of individual poverty through exposure to distressed physical environments (pollution, dilapidated housing, zoning), fragmented social networks (social support, norms, crime, political power) and limited health-related resources (health care, nutrition, recreation, transportation).[8][9]

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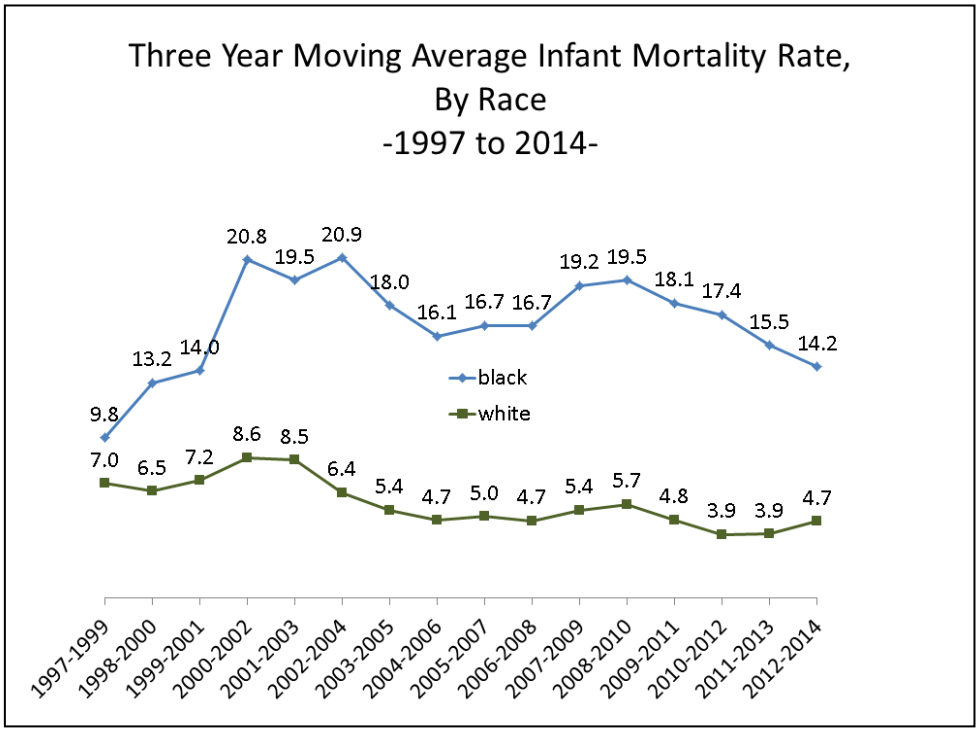
[1] Michigan Department of Community Health. (2015) Michigan Infant Death Statistics: January 1 through December 31, 2013. Michigan Department of Community Health; Division for Vital Records and Health Statistics.
[2] Mathews, RJ, MacDorman, MF, Thoma, ME. (2015) Infant Mortality Statistics from the 2013 Period Linked Birth/Infant Death Data Set. National Vital Statistics Reports. Vol 64, no 9.
[3] Smedley, B.D., Stith, A.Y. & Nelson, A.R. (eds) 2003, *Unequal treatment: Confronting racial and ethnic disparities in health care*, The National Academies Press, Washington, D.C.
[4] Link, B.G. & Phelan, J. 1995, "Social conditions as fundamental causes of disease", *Journal of Health and Social Behavior*, , pp. 80.
[5] Krieger, N. 2014, "Discrimination and health inequities", *International Journal of Health Services*, vol. 44, no. 4, pp. 643.
[6] Bloome, D. 2014, "Racial inequality trends and the intergenerational persistence of income and family structure", *American Sociological Review*, vol. 79, no. 6, pp. 1196.
[7] Osypuk, T.L., Galea, S., McArdle, N. & Acevedo-Garcia, D. 2009, "Quantifying separate and unequal racial-ethnic distributions of neighborhood poverty in metropolitan america", *Urban Affairs Review*, vol. 45, no. 1, pp. 25.
[8] Kramer, M.R. & Hogue, C.R. 2008, "Place matters: Variation in the black/white very preterm birth rate across U.S. metropolitan areas, 2002-2004", *Public Health Reports*, vol. 123, pp. 576
[9] Derose, K.P., Gresenz, C.R. & Ringel, J.S. 2011, "Understanding disparities in health care addess, and reducing them, through a focus on public health", *Health Affairs*, vol. 30, no. 10, pp. 1844-1851.

Previous analyses have identified that, within Kalamazoo, race and socioeconomic status (SES) interact to produce birth outcomes, such that Black race is associated with 2.5 times greater risk of low birth weight even after SES is taken into account, and that higher SES benefits Whites but not Blacks.[10] Further, as seen in Figure 1 below, the Black infant mortality rate (IMR) has varied over the last seventeen years in Kalamazoo County, from a low of 9.8 to a high of 20.9 during the 2002-2004 period. The related racial disparity has varied alongside it, from a low of 1.4 Black-White disparity during the same earlier 1997-1999 period to a high of 4.5 during the more recent 2010-2012 period. This high disparity rate is due the combined effect of low White IMR and high Black IMR. In the most recent 2012-2014 period, the Black-White disparity was 3.0 (14.2 Black IMR and 4.7 White IMR).

Figure 1. Infant Mortality Rate Trend, Kalamazoo County



Finally, as evident in the next table, Kalamazoo County leads the state in SUIDS among Black infants (45.1 deaths per 10,000 births) and in the raw difference in Black-White rates (45.1 – 7.6 = 37.6 rate difference).

[10] Kothari, C.L., Paul, R., Dormitorio, B., Ospina, F., James, A., Lenz, D., Baker, K., Curtis, A., Wiley, J. (under review). The Interplay of Race, Socioeconomic Status and Neighborhood Residence upon Birth Outcomes in a High Black Infant Mortality Community. *Health and Place.*

Table 1: Average number and rate of Sudden Unexpected Infant Deaths (SUIDS) among Black and White infants (MI 2009-2013, MI Birth cohort files appended with infant deaths (Birth Cohort))

	Mother's Residence at Birth	Total		Black		White		Rate Difference	Rate Ratio
		N	per 10,000 live births	N	per 10,000 live births	N	per 10,000 live births	B - W	B/W
1	Wayne	145	12.2	110	20.0	31	5.9	14.1	3.4
	Detroit	108	20.5	96	31.5	9	1.7	29.8	18.4
2	Oakland	37	5.6	9	8.3	22	4.6	3.7	1.8
3	Genesee	32	12.5	16	21.7	16	9.4	12.3	2.3
4	Kent	31	7.0	11	19.1	19	5.4	13.7	3.5
5	**Kalamazoo**	**21**	**13.5**	**12**	**45.1**	**9**	**7.6**	**37.6**	**6.0**
6	Macomb	19	4.1	<6		13	3.8		
7	Calhoun	15	18.0	<6		11	16.9		
8	Muskegon	13	12.0	<6		8	10.7		
8	Saginaw	13	11.2	7	22.6	<6			
8	Washtenaw	13	6.9	<6		9	7.2		
11	Berrien	11	11.5	8	32.8	<6			
11	Ingham	11	6.7	<6		8	7.0		
11	Saint Clair	11	13.4	0		11	14.7		
	Statewide	491	8.6	192	18.0	164	3.9	14.0	4.6

Data source: Michigan Resident Infant mortality files, Michigan Resident Live Birth Files 2009-2013. Division for Vital Records & Health Statistics, MDHHS. Sudden Unexpected Infant Death was defined by the following ICD10 codes for cause of death on the death certificate: R95 (Sudden Infant Death Syndrome), Accidental Suffocation and Strangulation in Bed (W75) and all cases with an Unknown cause of death (R99).

As public health, healthcare and community agencies within Kalamazoo organize to respond to these troubling statistics, a deeper examination of the causes of infant deaths are needed, especially as these causes may vary by race and/or by SES. Furthermore, official vital records statistics, as a result of the effort to accurately link infant birth and death records, can lag by up to two years; which can interfere with a community's ability to identify and act upon emerging trends. Thus, an additional goal of the current study is to estimate infant mortality rates and trends to include the most current year, 2015.

Key Questions:

1) What is the trend of infant death frequency and rates, from 2010 to 2015, within Kalamazoo County?
2) What are the dominant differences in frequency/rates by race/ethnicity and by SES?
3) Do infant death causes vary by race/ethnicity, by SES or by the combination?

Section II: Process / Methodology:

This was a retrospective analysis of vital records data of infant births and infant deaths within Kalamazoo County Michigan, from 2010 to 2015. The 2010-2014 data were generated by the

Michigan Department of Community Health (MDCH), Division of Vital Records and Health Data Development, were exported as excel data files to the Kalamazoo County Health and Community Services, and subsequently shared, through a data use agreement, with the study investigator, Catherine Kothari PhD. Exported data files contained:

- Infant birth records
- Linked infant birth/death records

The 2015 counts were generated from a manual abstraction of:

- Infant birth abstracts submitted to the Michigan Department of Community Health
- Infant death certificates produced by Kalamazoo County Clerks' Office

Only a subset of the variables contained within infant birth and death records were used for this analysis. The electronic databases contain the same information as the infant birth abstract and the death certificate, except that the infant death database also includes the associated ICD-9/10 death codes. The table below describes the analytical variables included in the current study, their source dataset and the function they served:

Data set	**Variable(s)**	**Function**
Birth Records database/abstract Linked birth-death database/death certificate	*Identifiers:* maternal first, middle & last name, maternal date of birth, infant first, middle and last name, infant date of birth, birth certificate number, infant date of death, death certificate number -County of maternal residence at birth, county of birth, county of infant residence at death, county of death	To link infant birth and death records
Birth Records Database/abstract	*Maternal:* race, ethnicity, Medicaid-paid birth or not *Paternal*: race, ethnicity,	To analyze by race/ethnicity and SES
Linked birth-death database/death certificate	*Death characteristics:* Age at death, cause(s) of death ICD-9/10 codes, cause(s) and manner of death listed *Infant:* race, ethnicity *Maternal:* race, ethnicity *Paternal*: race, ethnicity	To analyze by infant age and cause of death -To analyze by race/ethnicity

This study was a sub-analysis of the study "Using Public Health Data to Examine Infant Mortality in Kalamazoo Michigan," with Institutional Review Board oversight provided by Western Michigan University.

<u>*Measurement:*</u> All counts/rates that are derived from birth abstract/death certificate data will contain the descriptive qualifier as an unofficial "estimate" until the linked infant birth/death dataset is available from MDCH Vital Records and the data can be confirmed. Total number of births for the estimates were calculated as the annual average number of births from the years 2010-2013. It is

important to note that an infant born in one calendar year may have died in the next, so the same birth-cohort of infants aren't necessarily captured in each calendar year.

Official racial categories are calculated separately from ethnicity and, for infant births, are based upon maternal race. For some cases, Hispanic ethnicity is coded as "other" in the race category, in addition to the Hispanic category. Infant death statistics, however are based upon infant race. This means that an infant whose mother is White and father is Black may be counted as White in the birth statistics, but mixed race in the death statistics. A further issue complicating racial categorization is that there is a growing number of multi-race individuals. In order to remain as similar as possible to official statistics, the official race definitions will be used for this analysis. Race will be dichotomized into: (a) White Only (infant, maternal race is indicated to be "white" or "White-multiple," and may include Hispanic ethnicity), and (b) People of Color (either infant or maternal race/ethnicity is indicated to be non-white including African American/Black, Native American, Pacific Islander, Asian, Middle Eastern, etc, and may include Hispanic ethnicity). Hispanic ethnicity is captured independently of race and a separate analysis is completed for ethnicity. For Hispanic births where race is coded as White, the race will be categorized as White, while Hispanic births where race is coded as "other" will be coded as "people of color." This categorization, and the terminology used has been informed by community agencies and members. The term "minority" is considered pejorative and, thus, will not be used. Instead, the term "people-of-color" will be used. Socioeconomic status (SES) is defined by whether or not infant delivery was Medicaid-paid or not. Finally, causes of deaths were categorized into:

- Natural (prematurity, congenital anomaly, infection/disease, complications of pregnancy/delivery)
- Non-Natural (unsafe sleep-related circumstances, accident, homicide)

This categorization was informed by FIMR (Fetal Infant Mortality Review) guidelines and definitions. It was completed by the principle investigator for the purposes of this analysis and may not align exactly with vital statistics records. Further, this categorization reflects the revised approach to eliminate the SUID-undetermined category and recode those cases as Non-natural sleep related. The original "Infant Mortality Trend Analysis," dated March 2016 conservatively coded "SUID-undetermined" cause deaths as a separate category. Subsequent consultation with Lindsay Gross (National SUID Case Registry) in June 2016 revealed that, within the SUID registry, all cases initially logged as "SUID-undetermined" cause have been found to be sleep-related once additional information was available, and so are now automatically coded as such. As a result, the revised "Infant Mortality Trend Analysis," dated June 2016 has adopted the same procedure, recoding nine SUID-undetermined deaths as "sleep-related" cause deaths.

Section III: Findings

Racial-Ethnic Distribution:

Over three quarters of Kalamazoo County births (77.1%) [11] were to White women. Of the remaining 22.9% non-White individuals, Black women accounted for eight out of ten (3,417 of the 4,226, 18.3% of the total births). Six percent (6.1%) of Kalamazoo County births during this same period were to women of Hispanic ethnicity. Among Hispanic women, 96.1% (1,083 of the 1,127 Hispanic women) were White. Of the remaining 3.9%, Black women again accounted for eight of the ten (43 of the 54, 3.8% of the total births).

Table 2. Racial Distribution of Kalamazoo County Births

	Maternal Race - Births		
	White	People of color	Total
AMERICAN INDIAN	(0) 0.0%	(10) 0.2%	(10) 0.1%
AMERICAN INDIAN MULTIPLE RACE	(0) 0.0%	(10) 0.2%	(10) 0.1%
ASIAN INDIAN	(0) 0.0%	(198) 4.6%	(198) 1.1%
ASIAN/PACIFIC ISLANDER MULT RACE	(0) 0.0%	(30) 0.7%	(30) 0.2%
BLACK	(0) 0.0%	(3182) 74.6%	(3182) 17.0%
BLACK MULTIPLE RACE	(0) 0.0%	(235) 5.5%	(235) 1.3%
CHINESE	(0) 0.0%	(77) 1.8%	(77) 0.4%
FILIPINO	(0) 0.0%	(37) 0.9%	(37) 0.2%
GUAMAN,CHAMORRO	(0) 0.0%	(4) 0.1%	(4) 0.0%
JAPANESE	(0) 0.0%	(6) 0.1%	(6) 0.1%
KOREAN	(0) 0.0%	(36) 0.8%	(36) 0.2%
NATIVE HAWAIIAN	(0) 0.0%	(2) 0.0%	(2) 0.0%
OTHER ASIAN	(0) 0.0%	(31) 0.7%	(31) 0.2%
OTHER PACIFIC ISLANDER	(0) 0.0%	(4) 0.1%	(4) 0.0%
OTHER RACE	(0) 0.0%	(366) 8.6%	(366) 2.0%
VIETNAMESE	(0) 0.0%	(38) 0.9%	(38) 0.2%
WHITE	(14231) 98.6%	(0) 0.0%	(14231) 76.1%
WHITE MULTIPLE RACE	(196) 1.4%	(0) 0.0%	(196) 1.0%
TOTAL	14427	4266	18693
	100.0%	100.0%	100.0%

Note: Figures are based upon the 2008-2013 period.

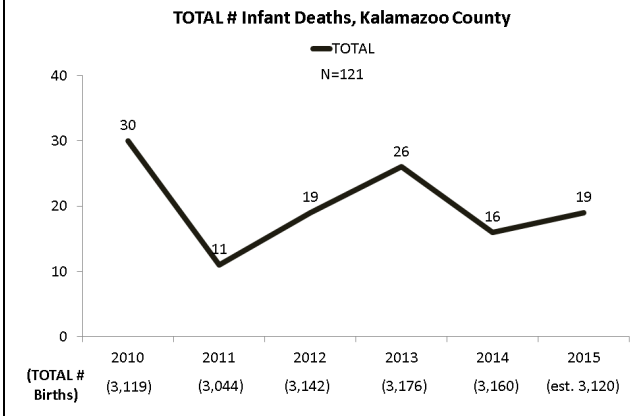
[11] Calculated using the 2008-2013 period

Temporal Trends, 2010-2015: As seen in Table 3 and plotted in Figures 2 and3, annual death numbers and rates can vary dramatically. (This is the primary reason for tracking trends as multi-year periods, most commonly three-year periods.) Nevertheless, the relative racial disparities are fairly consistent from 2010-2013, only to dip in 2014 and then increase dramatically in 2015. Please note that the 2010-2015 data reports all people of color combined, not just Black people.

Table 3. Infant Births & Deaths, Stratified by Race and SES, 2010-2015

	White		People of Color	
	Medicaid	**Non-Medicaid**	**Medicaid**	**Non-Medicaid**
Total Births, Period	5,278	9,228	3,218	1,009
2010	923	1470	565	156
2011	905	1451	527	155
2012	879	1573	527	161
2013	842	1590	555	180
2014	842	1623	500	194
2015	est. 887	est. 1521	est. 544	est. 163
Total Deaths, Period	31	24	54	12
2010	6	8	13	3
2011	5	0	6	0
2012	5	3	8	3
2013	4	8	10	4
2014	6	4	5	1
2015	5	1	12	1

Figure 2. Annual NUMBER of Infant Deaths, Kalamazoo County, 2010-2015



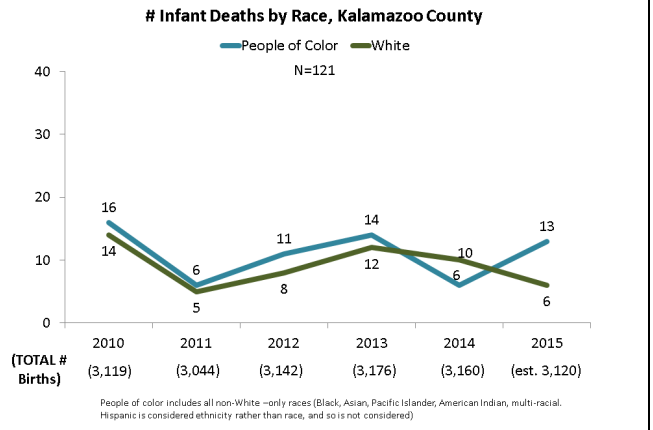
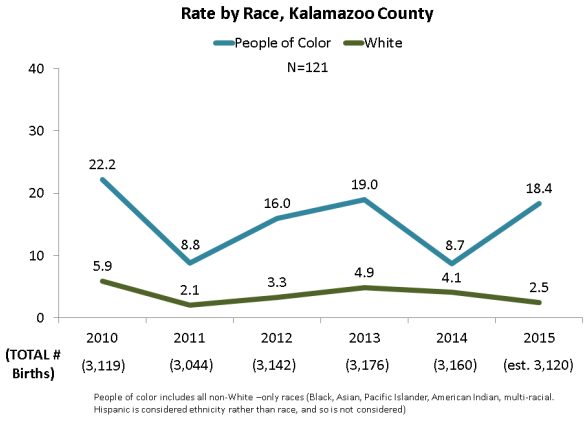
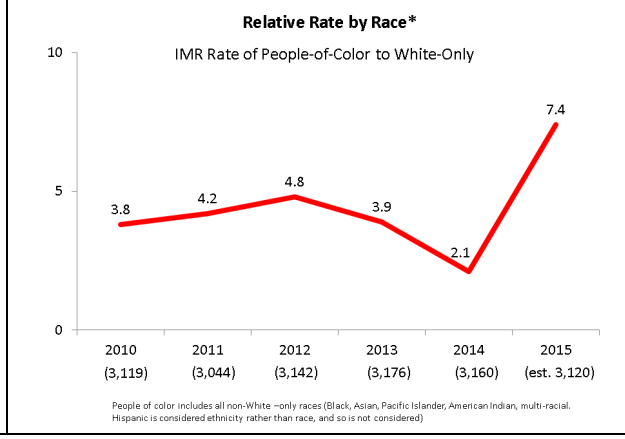


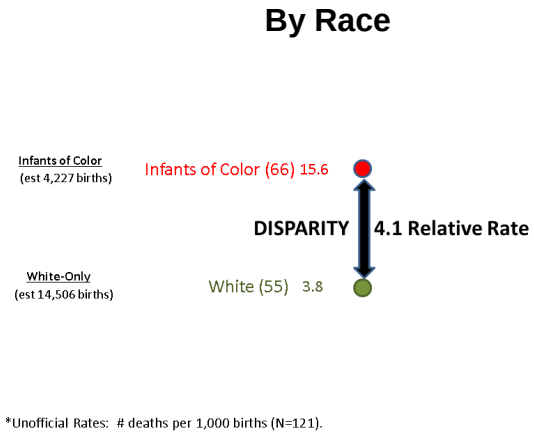
Figure 3. Annual RATES, by Race

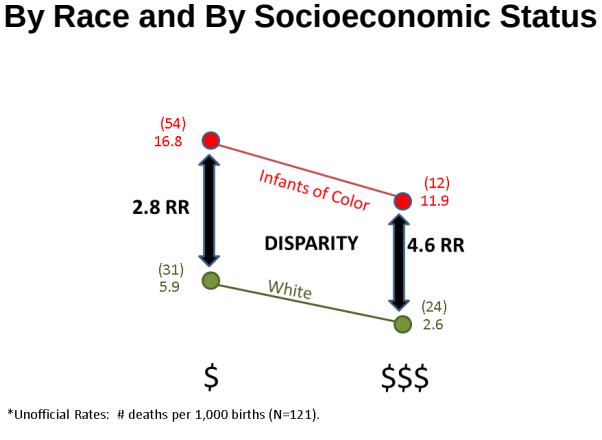




Period Trends, Stratified by Race & SES: Figure 4 charts below depict the overall period racial disparities; disparities that remain regardless of SES (indicated by insurance status) and, in fact, are greater among higher-income populations than among low-income populations. Low income people-of-color have the highest IMR rate (16.8 infant deaths per 1,000 births) and higher-income, private insurance white-only groups have the lowest (2.6 infant deaths per 1,000 births). Among low-income Medicaid populations, race-based IMR ratios are 2.8 (16.8 : 5.9), while among higher-income, private insurance populations, race-based IMR ratios are 4.6 (11.9 : 2.6). Note that higher-income infants of color die at twice the rate of low-income White infants. These findings are consistent with prior analyses of Kalamazoo County birth disparities noted in the introduction where low birth weight prevalence indicators show health gain with greater income for Whites but not for Blacks.[12]

Figure 4. 2010-2015 Period Rates, by Race & SES: Estimated Rate (#) of Deaths





[12] Kothari, C.L., Paul, R., Dormitorio, B., Ospina, F., James, A., Lenz, D., Baker, K., Curtis, A., Wiley, J. (under review). The Interplay of Race, Socioeconomic Status and Neighborhood Residence upon Birth Outcomes in a High Black Infant Mortality Community. *Population Health.*

Causes of Death, Stratified by Race & SES: Just as number/rates of death can vary over time, so do the reasons behind infant deaths. As shown in Figure 5, across the 2010-2015 period 30% of infant deaths have been due to non-natural (often termed "preventable") causes, ranging from 20.0% to 38.9%. Sleep-related deaths, a sub-category of non-natural deaths, include deaths due to co-sleeping, sleeping outside of a crib or sleeping with other objects inside the crib (such as blankets, toys or pillow). The number of sleep-related deaths is highly variable from year to year within the study period, ranging from 2 to 8 deaths in a year.

As shown in Figures 6 & 7 and Table 4, causes of death vary dramatically by race and, within race, by SES. A trend associated with SES is that higher-income infants almost exclusively die from natural causes, in contrast to low-income infants. As noted above, sleep-related deaths are largely the domain of low-income infants, most particularly for people-of-color. Over the six-year study period, the only sleep-related deaths to occur to White infants were 25.8% (8 of the 31 total).

Among higher-income people of color, prematurity accounts for two-thirds of infant deaths, nearly double the proportion of low-income people of color, and White infants, both low- and higher-income.

While relatively infrequent, when White higher income infants die, the primary reason is congenital anomalies and the secondary reason is prematurity. These are also the top two reasons White, lower-income infants die, but the order is reversed, such that prematurity is the top reason and congenital anomalies is the second most common reason.

Figure 5. Cause of Death Categories

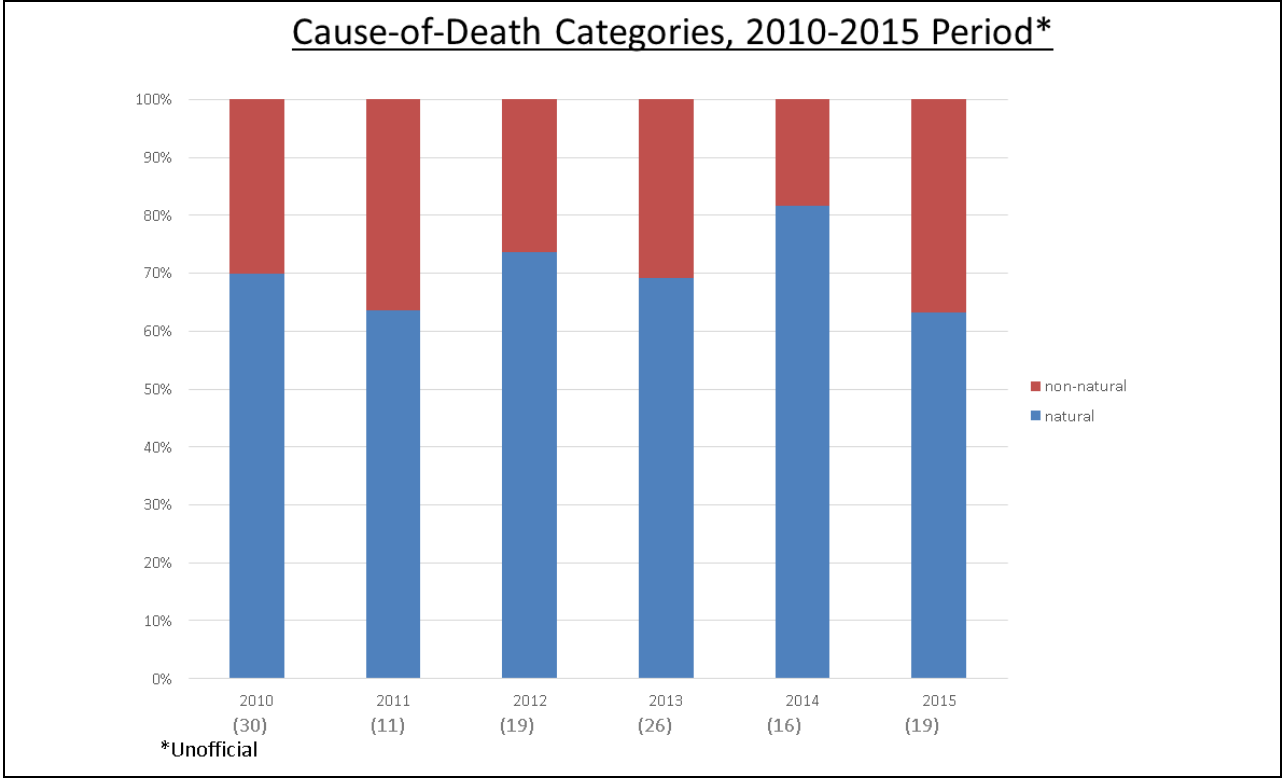
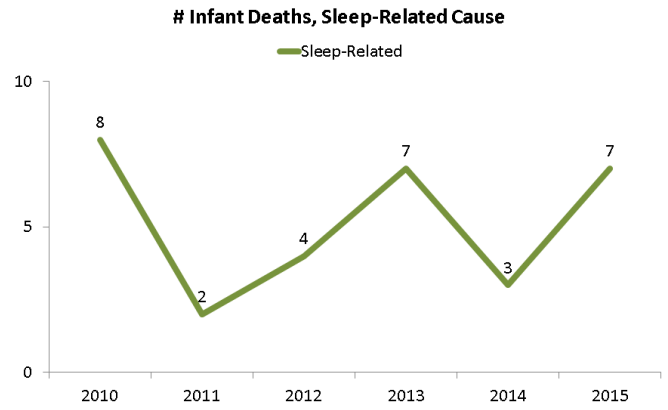


Figure 6. Sleep-Related Cause of Death: Total and Stratified by Race



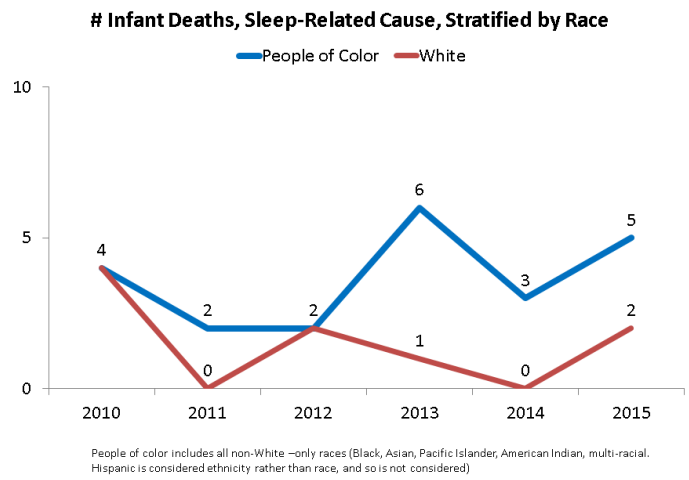
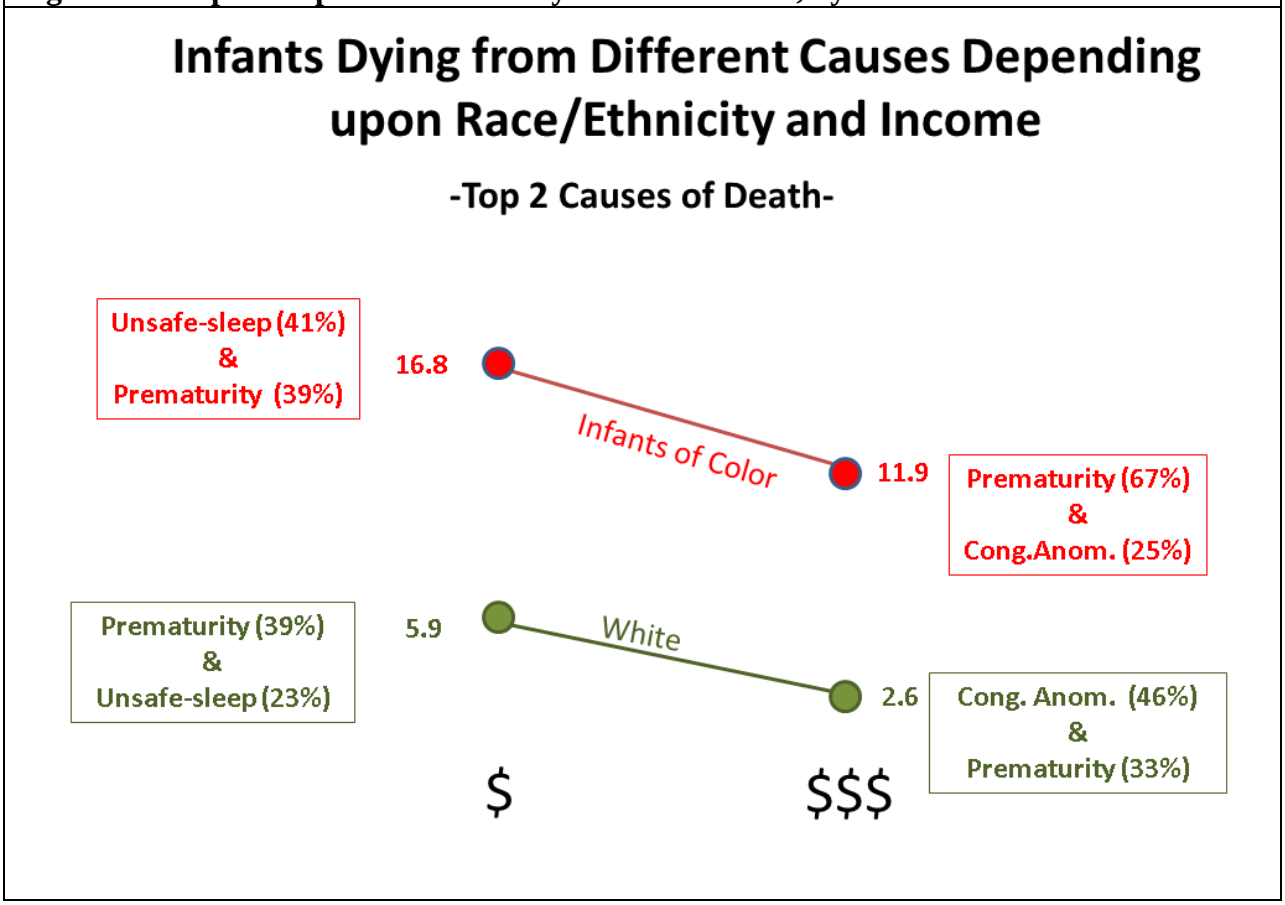


Table 4. Cause of Death by Race and SES

		People of Color		White-Only		
		Medicaid	Non Medicaid	Medicaid	Non Medicaid	Total
Non-Natural	Sleep-related	40.7% (22)	0.0% (0)	22.6% (7)	8.3% (2)	25.6% (31)
	Accident (non-sleep related)	1.1% (1)	0.0% (0)	6.5% (2)	0.0% (0)	2.5% (3)
	Homicide	0.0% (0)	0.0% (0)	3.2% (1)	4.2% (1)	1.7% (2)
Natural	Prematurity	38.9% (21)	66.7% (8)	38.7% (12)	33.3% (8)	40.5% (49)
	Congenital anomalies	11.1% (6)	25.0% (3)	16.1% (5)	45.8% (11)	20.7% (25)
	Infection / Disease	7.4% (4)	8.3% (1)	6.5% (2)	8.3% (2)	7.4% (9)
	Complications (pregn / delivery)	0.0% (0)	0.0% (0)	6.5% (2)	0.0% (0)	1.7% (2)
	TOTAL	54	12	31	24	121

Figure 7. Graphic Depiction of Primary Causes of Death, by Race & SES



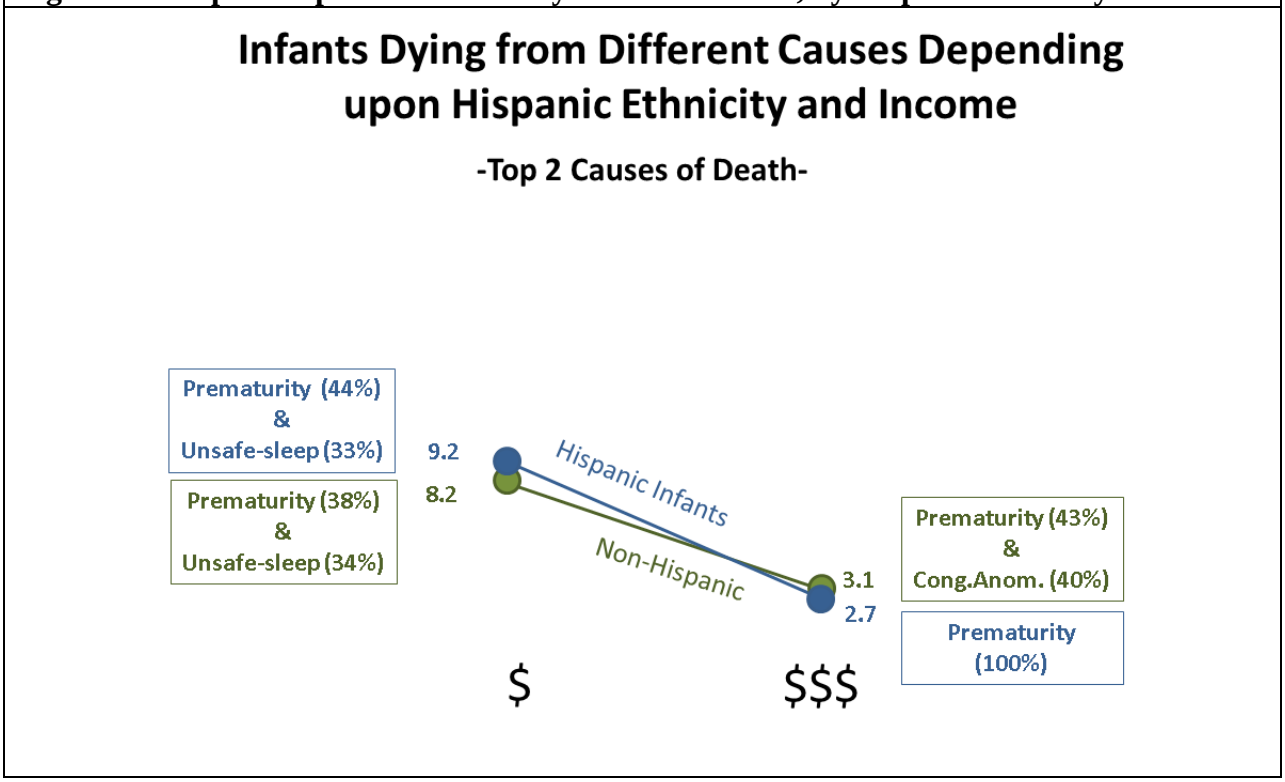
Causes of Death, Stratified by Hispanic Ethnicity & SES

Unlike race, there does not appear to be an overall ethnicity effect that is separate from the SES effect regarding cause of death. This includes sleep-related death causes. Among non-Medicaid families, prematurity is the primary contributing factor, followed by congenital anomalies among non-Hispanic, non-Medicaid families.

Table 5. Cause of Death by Hispanic Ethnicity and SES

		Hispanic		Non-Hispanic		
		Medicaid	Non Medicaid	Medicaid	Non Medicaid	Total
Non-Natural	Sleep-related	33.3% (3)	0.0% (0)	34.2% (26)	5.7% (2)	25.6% (31)
	Accident (non-sleep related)	0.0% (0)	0.0% (0)	3.9% (3)	0.0% (0)	2.5% (3)
	Homicide	0.0% (0)	0.0% (0)	1.3% (1)	2.9% (1)	1.7% (2)
Natural	Prematurity	44.4% (4)	100% (1)	38.2% (29)	42.9% (15)	40.5% (49)
	Congenital anomalies	11.1% (1)	0.0% (0)	13.2% (10)	40.0% (14)	20.7% (25)
	Infection / Disease	11.1% (1)	0.0% (0)	6.6% (5)	8.6% (3)	7.4% (9)
	Complications (pregn / delivery)	0.0% (0)	0.0% (0)	2.6% (2)	0.0% (0)	1.7% (2)
	TOTAL	9	1	76	35	121

Figure 8. Graphic Depiction of Primary Causes of Death, by Hispanic Ethnicity & SES



Conclusions

In a Healthy Start community, one long marked by high racial disparities in birth outcomes and infant mortality, this study adds to previous research by the principle investigator showing that both race and SES matter, and that there appear to be different causal pathways for four Race X SES populations: Low-income people of color, Higher-income people of color, Low income white individuals, and Higher-income White individuals.[13] [14] Several patterns have been identified:

- Infants of color consistently die at rates that are substantially higher than White infants, regardless of income status.
    - In fact, the racial gap is larger between higher-income individuals than between lower-income individuals.
- Although high among all infants of color, the reasons infants die varies significantly based upon income:
    - Many more lower-income infants of color die from sleep-related causes compared to higher income infants (of color, or white) and compared to lower-income white infants
    - Higher income infants of color are dying largely due to prematurity (nearly double that of any other racial-SES group)
- In 2015 the racial disparity grew to 7.4, primarily due to a rash of sleep-related deaths occurring primarily among low-SES families of color
- Among White and Hispanic families, being low-income increases risk of dying from 2-3 times, primarily due to prematurity and, among poor Hispanic families, sleep-related deaths
    - Unlike the broader people-of-color category (which is predominately Black families) higher income Hispanic families look very similar to higher income non-Hispanic families, both in infant mortality rates and in the causes of death.
- Poverty substantially increases infant mortality risk; the amount of increase varies by race and ethnicity
    - Among Hispanic infants the increase is 3.4 times higher risk of infant death, among Whites the increase amounts to 2.3 times higher risk, and among infants of color, poverty is associated with a 1.4 times higher risk of infant death
- Being "of color" brings infant mortality risk above and beyond that associated with poverty, especially among higher income populations
    - Among low-income families, being of color is associated with 2.8 times greater risk of death, while among higher income families, being of color is associated with 4.6 greater risk

The Effects of Race (excerpts from Kothari, et.al. manuscript, The Interplay of Race, Socioeconomic Status and Neighborhood Residence upon Birth Outcomes in a High Black Infant Mortality Community.)

"The social determinants of health theory, adopted by health agencies across the globe, explains racial inequity as the end result of social institutions that systematically disadvantage minorities (Smedley, Stith & Nelson 2003, Link, Phelan 1995, Krieger 2014). Within this framework, social

[13] Kothari, C.L., Paul, R., Dormitorio, B., Ospina, F., James, A., Lenz, D., Baker, K., Curtis, A., Wiley, J. (under review). The Interplay of Race, Socioeconomic Status and Neighborhood Residence upon Birth Outcomes in a High Black Infant Mortality Community. *Health and Place.*

[14] Kothari, C.L., Romph, C., Lenz, D., Bautista, T., Back, Y. (manuscript abstract accepted). Perinatal Periods of Risk Analysis: Disentangling Race and Socioeconomic Status to Inform a Black Infant Mortality Community Action Initiative. *Maternal and Child Health Journal.*

exclusion from economic participation and power is a major vehicle for institutionalized racism in the U.S. (Krieger 2014, David 2007, Popay et al. 2008). Poverty is experienced by 2.6 times more Blacks than Whites, extreme intergenerational poverty is more common among Blacks (Bloome 2014), and racially segregated Black neighborhoods consistently have greater concentrations of poverty (McLeod, Nonnemaker 2000, Osypuk et al. 2009). Living in segregated, high poverty communities further compounds the effect of individual poverty through exposure to distressed physical environments (pollution, dilapidated housing, zoning), fragmented social networks (social support, norms, crime, political power) and limited health-related resources (health care, nutrition, recreation, transportation) (Kramer, Hogue 2008, Williams, Collins 2001, Cook, McGuire & Zuvekas 2009, Ziersch et al. 2005, Derose, Gresenz & Ringel 2011).

A substantial body of research has documented that social stigma and racism account for much of the health disparities that persist after income is taken into account (Geronimus et al. 2006, Hatzenbuehler, Phelan & Link 2013, Aiello, Kaplan 2009). The cumulative effect of social devaluation, covert as well as overt acts of discrimination, and the costs of code-switching (having to adapt speech, posture and ways of interacting for daily life within a white-dominated society) have been tied to physiological weathering and ill health (Aneshensel 2015, Holzman et al. 2009, Sue et al. 2009, Cross Jr. 2012)."

The Effects of Poverty (excerpt from Kothari, et.al. manuscript, The Interplay of Race, Socioeconomic Status and Neighborhood Residence upon Birth Outcomes in a High Black Infant Mortality Community.)

"The health disadvantage that accompanies poverty is found throughout health research. Socioeconomic status, regardless of how it is measured (insurance status, education, household income, poverty level, wealth), has a strong graded relationship with maternal and fetal-infant health (intrauterine growth, prematurity, chronic disease, mortality, physical and mental health functioning) (Eudy 2009, McLeod, Nonnemaker 2000, Harding 2003, Walton et al. 2009, Nepomnyaschy 2009a)." Living under the stress of poverty impacts health knowledge, access / utilization of quality healthcare, health behaviors (smoking, exercise, diet, substance use) and chronic stressors (discrimination, violence, mental illness).

Sleep Related Deaths

Although SIDS/SUID//sleep-related deaths have declined by more than 50% since the early 1990s, it remains the leading cause of post-neonatal deaths.[15] A statewide analysis of 2010-2014 sleep-related deaths,[16] found that the rate of sleep-related deaths in Kalamazoo County was 16th out of 32 Michigan counties examined and higher than the State of Michigan overall (Kalamazoo County 1.6 sleep-related deaths per 1,000 births compared to Michigan 1.2, and a county range of 0.5 in Macomb County to 5.3 in Iosco County). In addition to the higher death rate among Black infants, Kalamazoo differed from other counties by having a higher rate of sleep-related deaths (roughly 87% in Kalamazoo) occur in an unsafe sleep location (adult bed, couch, etc). Similar to other counties, co-sleeping is a common contributing factor (approximately 66% of the time), as is sleep position on side or stomach (over half of the time among cases where sleep position is known). Other factors differentiating households where infants have died from sleep-related causes are having high smoking

[15] Kinney, H.C., Thach, B.T. (2009). The Sudden Infant Death Syndrome. *New England Journal of Medicine*. 361 (8): 795-805.
[16] Michigan Public Health Institute, Center for Child and Family Health. (April, 2016). *Sleep-Related Infant Deaths in Kalamazoo County.*

rates (60% of mothers of infants who died smoked during pregnancy, compared to 18% of all Michigan mothers), and low breast-feeding rates (32%of mothers of infants who died never breastfed, compared to 75% of all Michigan mothers).

Research has found that SIDS/SUID/sleep-related deaths are multifactorial, often involving internal risk factors and environmental conditions:[17]

Internal vulnerabilities

- Abnormalities involving metabolism, neurotransmission, response to infection (found in 50-75% of SIDS infants)
- Male infants die at twice the rate of female infants
- Deficits in cortical arousal (e.g., wakefulness, heart rate), ineffectual "gasping" reflex (which, in normal infants can restore interrupted oxygenation)
- Infection. Approximately half of SIDS cases, infants had a seemingly trivial infection around the time of death

Environmental which can cause death or trigger the death in vulnerable infants

- Prone (on stomach) sleeping position increases risk by a factor of three (due to airway compression, rebreathing of exhaled gases, overheating, and compromised arousal due to asphyxia)
- Other sleeping environmental risks include co-sleeping (about half of deaths involve co-sleeping), bedclothes that cover the head, sleeping on a soft mattress, sleeping on a furniture other than a bed, and overheating
- Prenatal exposure to smoking, alcohol or drug use (associated with reduced cortical arousal in infants)
- Postnatal exposure to household smoke (associated with reduced cortical arousal in infants)

The Triple-Risk Model has been adopted to explain the perfect storm that can lead to SIDS/SUIDS: (1) Underlying vulnerability in the infant (genetic abnormality, prematurity), (2) critical developmental period (maturation of cardiorespiratory control and cycling between sleep-wake), and (3) environmental stressor/condition (such as asphyxia). Infants without underlying vulnerability may die if caught in situations they cannot escape, such as wedged in between couch cushions or underneath another body.

Demographic Populations @ higher risk

- Race/ethnicity: American Indian, Alaskan Native and Black infants die from sleep-related causes two to seven times more often than White infants
- Infants born to poor mothers and living in conditions of poverty

Recommendations & Resources

In response to the differential pathways associated with race X SES populations (Low-income people of color, Higher-income people of color, Low income white individuals, and Higher-income White individuals), different preventive strategies need to be developed.

[17] Kinney, H.C., Thach, B.T. (2009). The Sudden Infant Death Syndrome. *New England Journal of Medicine*. 361 (8): 795-805.

Addressing poverty-related risk: *(excerpt from Kothari, et.al. manuscript, Improved Birth Weight for Black Infants: Outcomes of a Healthy Start Program.)*

" Maternal-infant programs shown to mitigate health risks associated with poverty have accomplished this by increasing access to healthcare through universal insurance, home visiting providers and Federally Qualified Health Centers (Khanani et al. 2010, Kothari et al. 2014, Avellar et al. 2012, Roman et al. 2014, Shi et al. 2004), improving nutrition through WIC (Khanani et al. 2010, Avellar et al. 2012, Roman et al. 2014, Shi et al. 2004), increasing health literacy through community health workers (Horvat et al. 2014, Lewin et al. 2010, Anderson et al. 2015), and enhancing social support with peers and mentors (Avellar et al. 2012, Ickovics et al. 2007, Meghea et al. 2016). "

Addressing race-related risk: *(excerpt from Kothari, et.al. manuscript, The Interplay of Race, Socioeconomic Status and Neighborhood Residence upon Birth Outcomes in a High Black Infant Mortality Community.)*

"While less research has been conducted regarding effective strategies for addressing racial stress and disempowerment, the following approaches have shown promise: practicing interpersonal responses to discrimination,(Brondolo, Gallo & Myers 2009) stress-reduction skill building(Brondolo, Gallo & Myers 2009, Collins Jr et al. 2004), culturally adapting healthcare delivery using community health workers, including racial congruity with provider and provider training in cultural respect (Sue et al. 2009, Horvat et al. 2014, Lewin et al. 2010, Anderson et al. 2015), and collective action that increases group solidarity, strengthens social networks and empowers political movement (Smith, Huo 2014, Pearlin 2010, Aneshensel 2015, Anderson et al. 2015)."

More research is needed to identify what, in Kalamazoo and across the country, are the specific sets of circumstances creating such toxic environments for mothers and babies of color. In the meantime, communities need to band together for explicit recognition that such circumstances exist, to build relational and resource bridges to disenfranchised populations, to empower them with respect, and to infuse them with authentic political power for cultural alignment of economic, educational, health and social systems.

Addressing Sleep-Related Risk

No single strategy, program or agency can effectively change the knowledge, skills, motivations and resources that families need to reduce sleep-related risk. Instead, collective action (all systems, all levels, professional and community working together) is called for. In support of this, a meta-analysis of safe sleep interventions found that effectiveness increased with:[18]

- Repeated messaging increases likelihood of safe-sleep practices (across perinatal periods, as well as across providers and settings)
- Multi-component, multi-pronged interventions that include
    - Education by healthcare providers (obstetricians, nurses, pediatricians, etc)
    - Reinforcement/education by social workers, public health workers, home visitors
    - Public and social media campaigns
- Targeting more than just mother. Include father, extended family, all infant caregivers, community members
- In addition to general approaches above, tailor and target messages to most high-risk groups

[18] Ward, T.C.S., Balfour, G.M. (2016). Infant Safe Sleep Interventions, 10990-2015: A Review. *Journal of Community Health*, 41: 180-196.

The American Academy of Pediatricians *Safe to Sleep* recommends:
-place to sleep on their BACKS (27% of infants currently placed on stomach or sides)
-in a CRIB with a firm mattress & fitted sheet
-ALONE
-with NOTHING ELSE in the crib (55% of infants placed to sleep with objects/blankets)
-in the SAME ROOM as parents

Also, reduce environmental risks known to trigger infant internal vulnerabilities, through …
-Regular prenatal care
-avoid smoke exposure
-avoid alcohol / drug use
-breastfeed
-consider offering pacifier during sleep
-avoid overheating
-immunize
-avoid commercial positional devices
-do not use home monitoring devices
-supervised awake tummy time

The state of Michigan advises:

Health professionals…

- Encourage parents to always place their baby in a safe sleep environment
- Provide individuals caring for pregnant women, infants, and caregivers with strategies to promote a consistent safe sleep environment. Free online training is available through the Michigan Department of Health and Human Services (www.michigan.gov/safesleep).
- Order brochures, posters, or DVDs about safe sleep through MDHHS Clearinghouse at www.healthymichigan.com or call 1-800-353-8227

Parents/Caregivers…

- Always place your baby in a safe sleep environment
- Do not allow smoking around your baby
- Breastfeed your baby, if possible
- Offer a pacifier when placing your baby down to sleep
- Be sure that everyone who cares for your baby knows how to place your baby down to sleep in a safe sleep environment
- If you are feeling overwhelmed or exhausted, ask for help. There are early childhood home visiting programs designed to assist families in caring for infants. They can provide you with support and connect you to the resources you need. To find a program in your area, go to www.michigan.gov/mihp.

Additional resources…

- National Institute of Child Health & Human Development *Safe to Sleep* Campaign. https://www.nichd.nih.gov/sts. Materials & media (pictures and videos) for fathers (especially Black fathers), grandparent education, healthcare/nursing providers,
- National Center for Education in Maternal and Child Health's National Action Partnership to Promote Safe Sleep, www.nappss.org

- Safe Sleep section, Association of State & Territorial Health Officials, www.astho.org/Programs/Access/Maternal-and-Child-Health/Safe-Sleep

The table below summarizes the evidence available for specific programs, trainings, or other components that have been shown to effect changes related to safe-sleep:

Practice	Description	Outcomes
Provider Training & Safe Sleep Audits	*Provided training and monitoring of safe sleep practices in birthing hospitals in county.*	*Hospital audits showed supine placement increased from 50% to 96%; cribs with blankets decreased from 22% to 1%; cribs with toys from 13% to 1%.*
Child Care Provider Training	*A new childcare curricula focused on child care settings was evaluated with unannounced observations and questionnaires*	*3 months after the intervention exclusive use of supine sleep position increased from 65% to 70.4% in control group and 87.8% in intervention group. Childcare provider awareness of AAP recommendations increased from 59.7% to 64.8% in control group and 80.5% in intervention group.*[6]
Brief Education in WIC	*In local WIC program a health educator led short educational interventions to discuss safe sleep practices with African American families as a prerequisite to obtaining food vouchers*	*Pre-training, 90% of parents co-slept, 21% planned to bed share, and 57.7% placed infant supine. After intervention, 85.3% planned to use supine position.*
Church-based health educators	*Project recruited peer health educators from African American churches to demonstrate safe sleep messages at church events and at a caregiver service centers.*	*Increased delivery of safe sleep messages by trusted, culturally concordant messengers*
Grandmother-focused media campaign	*Developed a series of media messages and training materials with a focus on grandmothers. Approach not only to inform grandmothers but to support parents' sense of self-efficacy*	*The overall campaign of which this was a part resulted in a increase on PRAMS data of supine sleeping from 43% to 76% over 5 years*
School-based campaign targeting pregnant/parenting teens	*Project worked with high schools for pregnant/parenting teens, using discussion and peer interaction that respected parents' power to make their own decisions about safe sleep*	*Changed policy and implementation in schools' childcare settings, safe sleep messages integrated into various lessons/classroom discussions.*
Black sorority-based health educators	*African American sororities trained members for their chapters and communities about rates of SUID in their communities and safe sleep*	*Sorority chapters have websites and Facebook accounts to promote safe sleep; chapters leveraged funding from NICHD grants to host 22 safety showers for at-risk pregnant women.*
Community education targeting family & caregivers	*Provided SIDS risk reduction education to largely black neighborhoods in Chicago. Education for family members and caregivers took place at community sites*	*Increases in knowledge and reported use of some safe sleep practices from a pre to post survey within the community.*
Public Health-based provider network campaign	*Trained community partners (Childcare, disability services, schools, early intervention, home visitors, literacy organizations, parent support organizations, faith-based organizations, coroner's office, and Department of Social Services) to talk with families to help assess caregivers safe sleep knowledge and practices and refer caregivers for education or for eligibility for a pack n play.*	*Partners check in with families over the course of the first year. The program reports that all babies involved in the program survived to their first birthdays*
Reducing second-hand smoke	*Stricter state-level regulations on smoking, higher cigarette prices and taxes*	*State-level reductions in SIDS cases.*

Finally, media campaigns targeting people-of-color should target ethnic media (television, radio, newspapers, websites) in addition to mainstream outlets.[19] In addition to a targeted venue, messages should be targeted as well. The first step is to identify the audiences most touched by sleep-related deaths or who are in a position to promote it (recruit community champions). Within ethnic communities, faith organizations are highly-regarded sources of information. Next, identifying the media outlets most used by these audiences, including any radio or local personalities who can spread the word. Also include social media (facebook, blogs, twitter, etc) of community leaders, local media personalities. Find families willing to share their story, families from the local community. Keep the messages simple and powerful, sound bites.

[19] Rodriguez, M., Horton, B., Bammarito, K. (2012). *Toolkit for Community Health Providers: Engaging Ethnic Media to Inform Communities about Safe Infant Sleep.* National Center for Cultural Competence, Georgetown University for Child and Human Development: Washington, D.C.