

Risk Factors among Participants in a Community Health Worker Led Infant Mortality Prevention Home-visiting Program

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ABSTRACT

Background: Complex behavioral, environmental, and medical risks need to be managed to reduce the risk of infant mortality. The Ohio infant mortality reduction initiative (OIMRI) program is attempting to reduce infant mortality by providing prenatal home visits to mothers at high risk for poor birth outcomes.

Objective: The purpose of this study was to compare the risk factors assessed by community health workers (CHWs) to those in birth records and Medicaid data to evaluate the risk factors for infant mortality among high-risk Black mothers enrolled in the OIMRI program.

Methods: OIMRI program data collected by CHWs were matched to birth records and Medicaid data for 2,812 participants between 2010 and 2015. Proportion tests, Chi-square tests, and confidence intervals were calculated to compare risk factors between time periods, datasets, and program participants and Black mothers in Ohio.

Results: The most common risk factors included unwanted pregnancy, homelessness or poor living conditions, or other (including low income, low support, or stress). Mothers in OIMRI reported smoking, anemia, and no prenatal care in the first 3 months to CHWs at statistically significantly lower rates than were reported in birth record or Medicaid data. Compared to all Black mothers in Ohio, OIMRI participants were significantly more likely to smoke before and during pregnancy, use alcohol or drugs, be enrolled in women, infants, and children, or have a diagnosis or receive services for mental health disorders.

Conclusion: Participants in OIMRI had multiple risk factors for infant mortality; it is important that infant mortality prevention efforts similar to OIMRI intervene on high-risk women to efficiently focus their efforts.

Key words: Community health workers, infant mortality, maternal health, risk factors

INTRODUCTION

While some infant mortality is due to genetic causes, many leading causes of infant death have medical, behavioral, and environmental risk factors that can be managed to mitigate infant mortality risk.^[1,2] Maternal

medical risks, which include hypertension and diabetes, can often be managed under the care of a physician.^[3-7] Behavioral risks, which include unplanned pregnancy, drug, alcohol, or tobacco use, poor nutrition, late or inadequate prenatal care, and stress, are harder to manage and can interact with environmental risks such as poverty, poor social support, and low food availability.^[8-15] Mothers who live in poverty,

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or in low-income or highly segregated neighborhoods, may experience multiple risk factors simultaneously.^[16]

Taken together, these risk factors weigh more heavily on Black communities and the mothers within them. For instance, one of the greatest risk factors for infant mortality is preterm birth, and the rate of preterm birth among Black mothers is 73.1% in comparison with a rate for the population of 66.3%.^[7,17] Similarly, Black mothers are likely to experience the risk factors of late or inadequate prenatal care, unintended pregnancy, stress, poverty, anemia, hypertension, and obesity more than other races.^[15,16,18] Despite reductions in Black–White infant mortality rate disparities in some states, there is still a significantly higher infant mortality rate among Black infants that programs need to address.^[19]

In an attempt to address these risk factors among Black women in the State of Ohio, the Ohio Department of Health (ODH) created The Ohio Infant Mortality Reduction Initiative (OIMRI) in 1994.^[20] The OIMRI program employs Community Health Workers (CHWs) who conduct home visits focused on mitigating the risk factors faced by Black women. CHWs are community members trained in an accredited program to act as public health workers who connect individuals who have traditionally lacked access to adequate care to care and support services.

As part of the OIMRI program, CHWs assess risk factors for participating pregnant women during the intake home visit through interviewing the participant and observing her home environment. These home visits take place in a participant's home or may occur at a shelter, public building, or the home of a friend or family member. Using this risk information, CHWs then attempt to tailor OIMRI program materials to address the risks that might contribute to poor birth outcomes. In this context, the ability of a CHW to accurately assess risk is crucial to program success. Yet prior research indicates that people underreport risk factors when self-reporting, and in cases where the effectiveness of the intervention depends on accurately assessing associated risks, the need for robust risk assessment is critical.^[21–23] As a result, there is a critical need to evaluate the accuracy and completeness of CHW risk assessments against objective data.

This paper evaluates the intake risk factor assessment conducted by OIMRI CHWs in comparison to data reported during prenatal clinic visits. Birth records and Medicaid data were used to corroborate the presence of similar risk factors as well as identify risks which were not included in the categories assessed by CHWs. As differences between risks identified by CHWs and those identified by medical personnel may represent unattended or mischaracterized needs among the population, the results of this study can inform future efforts that rely on subjective assessment of risk factors for infant mortality.

METHODS

Data from three sources were used in this study: OIMRI intake reports; Ohio Vital Statistics birth records; and the Ohio Medicaid Women of Reproductive Age dataset. First, OIMRI intake reports including data regarding intake date, risk factors, estimated weeks gestation at OIMRI intake, barriers to care, and recruitment method were obtained for 4,475 program participants. Risk factors were recorded by CHWs across 16 categories through interviewing participants about the presence of factors, an assessment of the mother's behavior, and an evaluation of her home environment. This list of risks was developed collaboratively by program administrators based on research and expert opinion. Risk factors included previous pregnancy with complications/poor outcomes, age under 18 or over 35, anemia, medical problems, second pregnancy within 12 months, pregnancy unwanted, late entry into prenatal care, non-compliance with keeping appointments, tobacco use, drug use, alcohol use, homelessness/poor living environment, domestic violence, mental retardation/mental illness, language barriers, and other (including stress, lack of support, and low income).

Intake reports were made available by the ODH, and 23-year periods were compared: 2010–2012 and 2013–2015. Cleaned data linked to birth records and Medicaid were only available for 2010–2015, limiting our analyses to these years; however, program-only data since 1996 were available. Data were also gathered from the Ohio Vital Statistics Birth records and the Medicaid Women of Reproductive Age dataset, and these data were then linked to OIMRI participants to form a matched dataset. Records were linked using the mother's date of birth, the child's date of birth, and ID numbers. In cases when the child's date of birth was not available in the OIMRI dataset, the intake date of the mother into OIMRI was used to determine whether a birth occurred after OIMRI enrollment. There were insufficient data to link some OIMRI participants to birth and death records, as not all participants have birth outcome data in the OIMRI dataset.

After the data were joined, duplicate records were identified and removed. A total of 2,812 records were matched with an intake year in the OIMRI dataset between 2010 and 2015. Risk factors were examined in this matched dataset among OIMRI data and birth record or Medicaid data to compare prevalence of reported risk factors for the same women. In addition, the entire unmatched birth record and Medicaid datasets were used to examine similar risk factors among all Black women in Ohio for the same time period.

For analysis, a pairwise deletion approach was used, and all available data were analyzed. Percentages were compared using proportion tests and are reported with 95% confidence intervals. Chi-square tests were used to test for the differences in frequencies of number of risk factors between the two

Table 1: Changes in reported risk factors, 2010–2015

| Risk Factor | 2010% (CI) | 2011% (CI) | 2012% (CI) | 2013% (CI) | 2014% (CI) | 2015% (CI) |
|----------------------------------------------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Pregnancy unwanted | 53.2 (49.6–56.9) | 58.8* (55.3–62.4) | 54.5 (51.1–58.0) | 51.4 (47.7–55.1) | 40.0* (36.5–43.5) | 47.6* (44.3–51.0) |
| Other (includes stress, lack of support, and low income) | 33.1 (29.7–36.5) | 32.7 (29.3–36.1) | 30.1 (26.9–33.2) | 34.8 (31.3–38.3) | 30.2 (26.9–33.5) | 23.5* (20.6–26.3) |
| Late entry into prenatal care | 19.9 (17.0–22.8) | 15.5* (12.9–18.1) | 14.9* (12.4–17.4) | 14.4* (11.8–16.9) | 17.8 (15.1–20.5) | 17.0 (14.5–19.5) |
| Tobacco use (smoking, snuff, etc.) | 17.8 (15.0–20.6) | 20.0 (17.1–22.9) | 17.6 (15.0–20.3) | 16.5 (13.7–19.2) | 15.4 (12.9–18.0) | 18.8 (16.2–21.4) |
| Homelessness/poor living environment | 12.8 (10.4–15.3) | 16.6* (13.9–19.3) | 24.5* (21.5–27.4) | 26.1* (22.9–29.4) | 23.6* (20.6–26.7) | 23.0* (20.2–25.8) |
| Medical problems (e.g., STD, UTI, and diabetes) | 11.5 (9.1–13.8) | 18.3* (15.5–21.1) | 14.9* (12.4–17.4) | 16.6* (13.8–19.4) | 15.8* (13.2–18.4) | 14.0 (11.7–16.3) |
| Age under 18 or >35 years old | 23.3 (20.2–26.4) | 18.3* (15.5–21.1) | 16.5* (14.0–19.1) | 19.6 (16.7–22.5) | 13.3* (10.9–15.7) | 11.7* (9.5–13.8) |
| Previous pregnancy with complications or poor outcomes | 14.1 (11.5–16.6) | 17.8 (15.0–20.6) | 15.0 (12.6–17.5) | 19.3* (16.4–22.2) | 16.5 (13.8–19.1) | 17.8* (15.3–20.3) |
| Second pregnancy within 12 months | 13.8 (11.3–16.3) | 14.1 (11.6–16.6) | 15.2 (12.7–17.6) | 11.9 (9.5–14.3) | 12.0 (9.7–14.3) | 13.4 (11.1–15.7) |
| Anemia | 12.8 (10.4–15.3) | 12.6 (10.2–15.0) | 12.3 (10.0–14.6) | 13.5 (11.0–16.0) | 10.3 (8.2–12.5) | 13.8† (11.5–16.1) |
| Non-compliance with keeping appointments | 5.4 (3.7–7.0) | 6.9 (5.1–8.8) | 5.3 (3.8–6.9) | 3.6 (2.2–4.9) | 5.0 (3.4–6.5) | 3.5 (2.2–4.7) |
| Language barriers | 3.6 (2.2–4.9) | 1.9* (0.9–2.9) | 2.6 (1.5–3.7) | 2.0 (0.9–3.0) | 1.6 (0.7–2.5) | 0.9* (0.3–1.6) |
| Drug use suspected | 3.7 (2.3–5.1) | 4.9 (3.3–6.4) | 2.9 (1.7–4.0) | 3.4 (2.1–4.8) | 3.8 (2.4–5.1) | 4.5 (3.1–5.9) |
| Domestic violence | 4.1 (2.7–5.6) | 3.4 (2.1–4.7) | 5.8 (4.2–7.5) | 3.3 (2.0–4.6) | 3.9 (2.5–5.3) | 3.9 (2.6–5.2) |
| Mental retardation/mental illness | 4.7 (3.2–6.2) | 5.7 (4.0–7.4) | 6.5 (4.8–8.2) | 4.7 (3.1–6.3) | 4.4 (3.0–5.9) | 7.4* (5.7–9.1) |
| Alcohol use suspected | 3.3 (2.0–4.6) | 4.2 (2.8–5.7) | 2.2 (1.2–3.3) | 1.7 (0.7–2.7) | 2.4 (1.3–3.4) | 1.9 (1.0–2.7) |

*Value statistically significant compared to 2010 at $P < 0.05$ level. CI: Confidence interval

3-year periods of 2010–2012 and 2013–2015. Values are considered statistically significant at the $P < 0.05$ level, without adjusting for multiplicity. All quantitative analyses were performed using Stata version 14 (2015, StataCorp LP, College Station, TX). This research was conducted with approval from the Institutional Review Board of the authors' institution.

RESULTS

Reported risk factors

Using 2010 as a reference year, Table 1 shows how the prevalence of risk factors reported by participants has changed based on CHW reports of 4,475 participants from 2010 to 2015. We found changes from the baseline year (2010) for each subsequent year. Across program years, there was a significant reduction in the prevalence for a number of risk factors. Notably, factors related to the circumstances of the pregnancy (i.e., unwanted pregnancy, late entry into prenatal care, and age of the mother) saw a decrease over at least 1 year since 2010, with the reduction in the risk factor “age under 18 or over 35” showing a steady decrease. In contrast, the prevalence of the homelessness/poor living environment risk factor notably increased over the course of the same time frame.

Number of reported risk factors

As risks identified are not mutually exclusive, a mother can experience a number of them at the same time. We categorized simultaneously reported risk factors into 0, 1, 2, 3, 4, and 5 or more risk factors and assessed these risk factor categories across the three identified time windows since data collection began in 1996, 2010–2012, and 2013–2015, as displayed in Figure 1.

When compared to 2010–2012, we found an increase in the percentage of participants with zero or one risk factor and a decrease in the percentage of participants with four, five, or more risk factors in 2013–2015. There was a significant

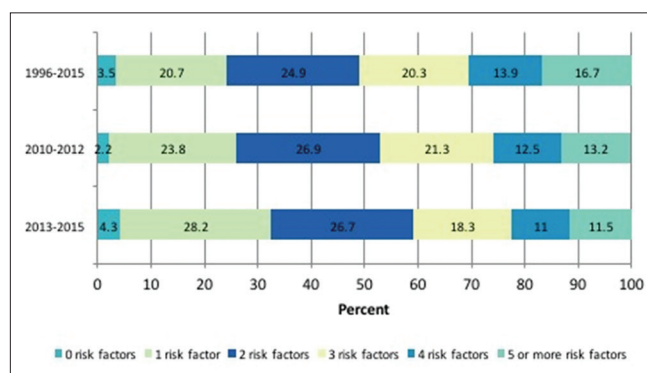


Figure 1: Number of reported risk factors, non-mutually exclusive

difference ($P < 0.001$), with women experiencing greater numbers of risk factors simultaneously during the 2010–2012 time period. The majority of participants throughout program history (1996–2015) (75.8%) experienced two or more risk factors simultaneously, and 96.5% of participants throughout program history experienced at least one risk factor.

Reported risk factors corroborated using birth record and WRA data

Among OIMRI participants who could be directly matched to Birth Record and WRA data, we compared risk factors measured by OIMRI self-report to the same risk factors among OIMRI participants using either objective data source for the years 2010–2015 [Table 2]. We also assessed risk factors for all Black women who gave birth in Ohio using WRA or Birth Record Data during the same years.

As shown, we found that Black mothers in OIMRI self-report smoking, anemia, and prenatal care in the first 3 months at statistically significantly lower rates in the OIMRI data (Group A) than Medicaid or Ohio Birth record data show as rates for the same moms (Group B). In addition, in comparison to all Black mothers in Ohio (Group C), a higher proportion of OIMRI mothers used alcohol or drugs or smoked and a lower proportion had anemia in the birth and Medicaid data (all $P < 0.05$).

Additional risk factors examined using WRA and birth record data

Using WRA and Birth Record Data, we examined additional risk factors that were not assessed by CHWs, comparing the percentages for OIMRI mothers (Group A) to percentages for all Black mothers who gave birth in Ohio (Group B) from 2010 to 2015 [Table 3]. Among OIMRI mothers, we Compared to all Black mothers in Ohio, larger proportions of OIMRI mothers smoked before pregnancy, were enrolled in the women, infants, and children (WIC) program, or had received services for or been diagnosed with a mental health disorder (all $P < 0.05$). OIMRI mothers were less likely to have gestational diabetes or a previous preterm birth than all Black mothers in Ohio ($P < 0.05$). However, mothers in OIMRI were similar to all Black mothers in Ohio for the risk factors of hypertension during pregnancy, previous preterm labor, and previous infant mortality.

DISCUSSION

The OIMRI program successfully recruited high-risk Black women who were more likely than Black women across the state to smoke, use alcohol or drugs, be enrolled in WIC, or have mental health disorders. Participants in OIMRI had high rates of homelessness and poor housing, unwanted pregnancy, and other environmental risk factors. The majority (75.8%) of participants for the history of the program experienced 2 or

Table 2: Risk factors comparison among datasets: 2010–2015

| Risk factor | A. OIMRI mothers - self-reported (%) | B. OIMRI mothers - external data (%) | C. Black mothers in Ohio (%) |
|--------------------------------------------------|--------------------------------------|--------------------------------------|------------------------------|
| Alcohol or drug abuse suspected during pregnancy | 5.4 (4.6–6.3) | 6.7 [†] (5.7–7.7) | 4.5 (4.4–4.6) |
| Smoking during pregnancy | 18.2* (16.8–19.7) | 24.3 [†] (22.7–25.9) | 13.5 (13.3–13.6) |
| Anemia during pregnancy | 12.8* (11.6–14.1) | 23.9 [†] (22.2–25.1) | 25.7 (25.4–26.0) |
| No prenatal care in first 3 months | 28.1* (26.2–30.1) | 40.3 (38.4–42.4) | 40.2 (39.9–40.4) |

A. OIMRI participants based on OIMRI self-report data. B. OIMRI participants based on Ohio Birth records or Medicaid. C. All Ohio black women based on Ohio Birth records or Medicaid. *Statistically significant difference between A and B. [†]Statistically significant difference between B and C

Table 3: Additional risk factors from WRA and Birth Records, 2010–2015

| Risk factor | A. OIMRI mothers (%) | B. Black mothers in Ohio (%) |
|------------------------------------------------------------|----------------------|------------------------------|
| Smoking before pregnancy | 29.1* (27.6–31.1) | 18.0 (17.8–18.2) |
| Gestational diabetes | 8.7* (7.6–9.8) | 10.2 (10.0–10.4) |
| Hypertension during pregnancy | 12.8 (11.5–14.0) | 13.7 (13.5–13.9) |
| Mother in WIC | 86.1* (84.8–87.4) | 66.5 (66.3–66.7) |
| Receipt of services or diagnosis of mental health disorder | 14.6* (13.3–16.0) | 12.0 (11.8–12.1) |
| Previous preterm birth | 6.5* (5.6–7.4) | 7.9 (7.7–8.0) |
| Previous preterm labor | 9.0 (7.9–10.1) | 8.4 (8.2–8.6) |
| Previous infant mortality | 2.6 (2.0–3.2) | 2.7 (2.6–2.8) |

A. OIMRI participants based on Ohio Birth records or Medicaid. B. All Ohio black women based on Ohio Birth records or Medicaid.

*Statistically significant difference between A and B at $P < 0.05$ level

more risk factors simultaneously. Finally, in examining risk factors for infant mortality among Black mothers in Ohio, we found some variability when using different data sources. For instance, tobacco use, anemia, and late entry into prenatal care were statistically significantly more common among participants when analyzing birth record or Medicaid data than when using self-reported OIMRI data.

Several factors may contribute to the differences in risk factor prevalence rates between data sources. First, OIMRI participants may have been unwilling at program intake to disclose to a CHW some risk factors they perceived to be undesirable (e.g., smoking and drug use), but they may have been less reluctant to disclose to a health-care practitioner they met multiple times that they smoke a few cigarettes a day. Women are more engaged in prenatal care if they have a trusting relationship with their provider,^[24] and this could have an effect on whether mothers report risk factors. This social desirability bias has been documented in previous research; pregnant women were found to be less likely to disclose smoking status than non-pregnant women, and among pregnant women, young women (20–24 years old) were less likely to disclose smoking status.^[25] In addition, OIMRI records risk factors as binary; a participant may not perceive themselves as a “smoker” if they have only a few cigarettes a day. Similarly, underreporting may be a particularly salient problem for self-reported data when risk factors are unknown

at a particular point in time. For example, a mother may not have known that she had anemia at the time of the CHW’s intake assessment making self-report impossible, but other data sources will include anemia as a risk factor.

Among risk factors for infant mortality, unintended pregnancies are reportedly frequent among all women across Ohio, with 55% of pregnancies reported as unintended and 31% of those unintended pregnancies reportedly unwanted (total unwanted pregnancy rate of 17%).^[26] Notably, this rate is much lower than the unwanted pregnancy rate of 40–59% self-reported among OIMRI participants from 2010 to 2015. Since women with unplanned and/or unwanted pregnancies are more likely to have poor health behaviors during pregnancy including smoking, poor nutrition, and late or inadequate prenatal care,^[27] the ability for CHWs to identify this risk factor and intervene, when possible, may be extremely important.

During their home visit intake assessment, the mothers in OIMRI were more likely to be high-risk. Could be reworded to “CHWs were able to identify women who used drugs or alcohol, smoked before and during pregnancy, or suffered from mental health problems at greater rates than average in Ohio. As each of these risk factors contributes to the constellation of challenges faced by mothers with low means, including poor nutrition, smoking, substance abuse, poor

prenatal care, infections, psychological factors, and poor housing/neighborhoods,^[28] identification is an important first step to mitigate these risk factors.

Further, while the rate of homelessness in Ohio in general is <1% of the population,^[29] the homelessness or poor living environment rate for OIMRI participants ranged from 12.8% to 26.1% during 2010–2015 in the OIMRI data. It is impossible to split the data into true homelessness versus poor housing; however, this still indicates high-risk environments. Both homelessness and living in neighborhoods with a low socioeconomic status are associated with excess morbidity and mortality.^[30,31] These rates suggest that OIMRI participants may experience additional poverty-related risk factors common among those with housing insecurity (e.g., unemployment/underemployment, lack of social support, and poor nutrition) not systematically captured by the current OIMRI assessment process, birth records, or Medicaid records that contribute to infant mortality. Additional prenatal data collection would likely help further to improve intervention activities aimed at reducing infant mortality by permitting identification of such risks.

There were strengths and limitations to these analyses. Use of multiple data sources allowed for risk factors to be compared between medical providers and community services. However, underreporting of risk factors is a limitation of the OIMRI self-report data. As risk assessment occurs at the first home visit, before trust is built between the CHW and the participant, it is possible that women purposely underreported risk factors about sensitive topics. Further, participants may have other risk factors not listed in the reported categories. Additionally, participants may have unintentionally underreported risk factors they did not personally consider risk factors (e.g., low income). There is likely underreporting in the birth records and Medicaid data as well. In addition, while using many years of data allowed for the analysis of changes in the population, due to program dropout, change in risk factors for participants over time could not be assessed. Future analyses could include additional risk factors available from external datasets, as well as analysis of frequently co-occurring risk factors.

CONCLUSION

Women in the OIMRI program reported multiple risk factors that contribute to infant mortality. The most common risk factors were unwanted pregnancy, homelessness or poor living conditions, and “other,” which most frequently consisted of low income, low support, or stress. At the same time, OIMRI participants were also more likely than all Black women in Ohio to be enrolled in WIC, use drugs or alcohol, smoke, and have mental health issues from 2010 to 2015. OIMRI participants self-reported smoking, late prenatal care, and anemia at lower rates to CHWs than to medical professionals, highlighting a divide in risk reporting. As programs such as

OIMRI that rely on CHWs to provide interventions depend on accurate assessments of risk factors to optimally allocate limited programmatic resources, developing ways to ensure complete reporting of such risk factors are critical.

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