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Addressing Health Disparities: The Health Department Nurse Lead Executive's Relationship to Improved Community Health

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Abstract

Context: The nurse-trained local health department (LHD) lead executive has been shown to be positively associated with LHD performance; however, no other research has explored whether this association translates to improved community health.

Objective: To investigate the relationship between the type of LHD leadership—whether or not the lead executive is a nurse—and changes in health outcomes.

Design: This study used a multivariate panel time series design. Each model was estimated as a pooled time series and using time and unit fixed effects, with a 1-year lag used for all covariates and the main predictor.

Setting: A national, county-level data set was compiled containing variables pertaining to the LHD, community demographics, and health outcomes for the years 2010–2018.

Participants: The unit of analysis was the LHD. The data set was restricted to those counties with measurable mortality rates during at least 8 of the 9 time periods of the study, resulting in a total of 626 LHDs.

Main Outcome Measures: The outcomes of interest were changes in 15- to 44-year-old all-cause mortality, infant mortality, and entry into prenatal care.

Results: In models with combined time and unit fixed effects, a significant relationship exists between a nurse-led LHD and reduced mortality in the 15- to 44-year-old Black population (−5.2%, $P < .05$) and a reduction in the Black-White mortality ratio (−6%, $P < .05$). In addition, there is a relationship between the nurse-led LHD and a reduction in the percentage of the population with late or no entry to prenatal care.

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Conclusions: The evidence presented here helps connect the known positive association between nurse lead executives and LHD performance to improvements in community health. It suggests that nurse leaders are associated with health improvements in line with addressing health inequities.

Keywords

health equity; local health departments; nurse leadership; pregnancy outcomes; public health nurses

Local health departments (LHDs) serve a vital role in supporting health equity and population health improvements. LHDs mainly fulfill this role by ensuring that appropriate and effective services are available to those who are most under-served, engaging in policy work to address public health issues, and implementing programs targeted toward promoting population health.[1] Several studies have demonstrated that the LHD top executive with a nursing degree (nurse lead executive) is positively associated with an LHD's performance of these responsibilities; however, no identified research has explored whether such an association translates to community health improvements.[2,3] Furthermore, decreased public health funding over time has impacted LHD capacity to carry out its responsibilities to protect the public's health; the current COVID-19 pandemic has demonstrated the negative effects of this reduced capacity.[4] Thus, to guide LHDs in effectively using limited resources, a deeper understanding of which LHD factors might be influential in supporting a population's health is needed.

A small number of research studies have explored the relationship between factors important to LHD performance and community health. A majority of these studies have focused on the relationship between public health spending and health outcomes[5–8]; others have focused on predictors such as partnerships,[9] staffing,[10] and service provision.[11,12] Only one, conducted by Bekemeier et al,[13] focused on the impact of leadership. This study found that the presence of a clinician lead executive, either a nurse or a physician, was positively associated with reductions in Black-White mortality disparities. This study was also unique in its examination of disparities. A majority of the previously discussed studies have focused on the overall population, resulting in a persistent gap in understanding which populations benefit most from public health interventions.

No investigations have specifically examined the influence of LHD nurse lead executives on health outcomes, despite research indicating that nurse leaders possess certain attributes important for employing strategies to effectively address problems in public health. This includes being partnership-oriented, utilizing a transformational leadership style, and having had training grounded in social justice and which emphasizes a holistic view of health.[14–16] Such leadership qualities are associated with improved LHD capacity to address health disparities and indicate that nurse leaders are likely to support the LHD in successfully addressing health inequities.[17]

Continued increases in health disparities, particularly related to maternal and child health (MCH), underscore the need to understand how leadership can influence these outcomes. For example, infant mortality in the Black population is 10.8 per 1000 live births as

compared with 4.6 per 1000 live births in the White population.[18] Such disparities are also present in perinatal health outcomes.[19] Mortality disparities between Black and White populations have narrowed somewhat over time but continue to persist, particularly in rural areas.[20] Past research found that nurses are more likely to focus on prevention and MCH services and thus likely to target these disparities in their work.[21]

Research supports the fact that nurse lead executives are associated with improved LHD performance; this study builds on that evidence in exploring whether that association translates to improvements in population health. While this study cannot fully address equitable health improvement, it takes a systems approach through a focus on leadership, understanding that effective leadership is a "prerequisite" that is needed to support better health outcomes.[1] Thus, to grow our understanding of public health systems factors important for community health, this study examined relationships between the type of public health leadership—whether or not the lead executive is a nurse—and changes in 15- to 44-year-old all-cause mortality, infant mortality, and percentage of the population with late or no entry into prenatal care.

Methods

This study used a multivariate panel time series design to examine the temporal relationships between nurse versus non-nurse lead executives and changes in health outcomes in the population as a whole, as well as within Black and White subpopulations.

Conceptual framework

A conceptual framework, developed for this study, illustrates the process by which the nurse lead executive can support equitable health outcomes (Figure). It is based on a model developed by Hajat and colleagues[22] that is focused on the local public health system; however, it also utilizes concepts from the Social-Ecological Model as well as the System of Prevention framework.[23,24]

In this framework, the lead executive, with specified attributes and competencies such as a transformational leadership style and commitment to social justice, is shown to operate directly through 4 major mechanisms: the local board of health; partnerships; accreditation; and funding/expenditures. Effective leveraging of these mechanisms results in improved LHD performance as evidenced by a competent workforce, completion of a community health assessment, the presence of evidence-based practices and policies, and engagement in quality improvement activities.[5,6,25–27] This leads to an increased breadth of services targeted to the community's needs as well as community partnerships, which supports improved outcomes in the community.[11,12] This set of factors is expected to lead to equitable improvements in community health when the leader operates from a health equity perspective and integrates this perspective throughout the LHD. This perspective acknowledges that health outcomes are the result of multiple injustices ingrained in current structures and systems, such as systemic racism, poverty, and gender inequality. It is evidenced by factors such as a workforce competent in the social determinants of health (SDOH), community partnerships focused on the SDOH, and policy advocacy activities.[17] Finally, this model acknowledges that the LHD operates amid many systemic factors that

affect disparities: public policy, corporations, community characteristics, and issues such as systemic racism and gender inequality.[28]

Data and variable selection

A national, county-level data set was compiled, combining data related to the LHD, community demographics, and health outcomes as reflected in the conceptual framework (Figure). This study received an exemption from the University of Washington's institutional review board.

Data pertaining to LHD leadership and other organizational variables came from the 2010, 2013, and 2016 National Profile of Local Health Departments (*Profile*) surveys. This data set contains information on LHDs—which typically serve a single county but can serve multiple cities or counties—with variables specific to the LHD's organization, infrastructure, workforce, and practice, including the lead executive characteristics and types of agency activities performed. The 2010–2018 county-level health outcomes selected as dependent variables came from the CDC WONDER database. The 2010–2018 county-level demographic variables were retrieved from the Area Health Resource File. These 3 data sets were linked together using county-level FIPS codes.

Dependent variables were chosen on the basis of their ability to show changes over a reasonably short period of time in addition to previous longitudinal research demonstrating relationships between such outcomes and LHD factors such as type of leadership.[5,6,8–13] The dependent variables include all-cause mortality rates among 15- to 44-year-olds, infant mortality rate, and percentage of pregnant people with late or no entry to prenatal care (those beginning prenatal care after the 6th month of gestation). All were measured at the total population level as well as in Black and White populations. This analysis specifically examined outcomes in Black and White populations as data sources did not provide outcome data for other racial groups at the county level. Fifteen- to 44-year-old mortality rates were measured per 100 000 population. Infant mortality rates were measured per 1000 live births and were constructed using 3-year smoothed rates, due to small numbers in some counties (2009/2010/2011–2017/2018). The last smoothed rates were measured over 2 years, due to the lack of 2019 data available at the time. Data for counties with fewer than 20 annual deaths (either for 15- to 44-year-olds or infants) were excluded because of unreliable measurement of the mortality ratio. In addition, the CDC WONDER database suppresses infant mortality data for counties with less than 250 000 population. These restrictions on data access resulted in mainly reducing the number of rural counties represented in the data. Finally, from 2007 to 2015, prenatal care entry data from states using the 1989 version of the birth certificate (as opposed to the 2003 revised version) were coded as "excluded" in the CDC WONDER database and therefore were not available for analysis for this study.

Leadership measures

The main independent variable was measured using *Profile* data, indicating whether the LHD was "nurse-led" (lead executive has an ADN, BSN, MSN, and/or DNP degrees) or "not nurse-led" in 2010, 2013, and/or 2016. Other lead executive characteristics were

considered but were not included because of each being a near constant in the sample (ie, 90% fulltime, 95% tenure <5 years).

Other measures

Two other sets of covariates were included that are associated with health outcomes in the community (Figure). The first set of covariates—community demographics, community need, and health resources available—all relate to upstream factors known to affect health outcomes.[12,28] Variables were retrieved from the Area Health Resource File, including % non-Hispanic Black, % Hispanic, % uninsured, % population 19 years or younger, % population 65 years or older, number of providers (MD, DO, and nurse practitioners) per 1000 population, and rural/urban designation. LHDs were characterized as metropolitan (urban), micropolitan, or rural based on the 2010 Rural-Urban Commuting Area Codes.[29] A disadvantage index was included from summing the *z*-scores for county-level % poverty, % unemployed, and % with less than a high school diploma. This was modeled after similar previous research.[10,30] All variables were time-variant except for % Black, % Hispanic, and rural/urban designation.

The second set of covariates included *Profile* survey LHD organizational variables. Each variable is documented in the literature as having a relationship to better community health outcomes: the number of full-time equivalents, the presence of a local board of health with policy-making authority, completion of both a community health assessment and a community health improvement plan, and the count of services provided in each of 10 service domains representing breadth of service provision.[10,12] These domains are MCH, immunizations, treatment, screening, health services, epidemiology and surveillance, population-based services, regulation, environmental health, and other services. LHD expenditures were not selected as a covariate due to a significant amount of missing data pertaining to expenditures (42%).

Sample

After data were linked using the county-level FIPS codes, the data set was restricted to LHDs that responded to all 3 *Profile* survey years studied (1315 LHDs). It was further restricted to the jurisdictions that had one or no missing outcome variables during the study time period, resulting in a total of 626 LHDs. Most LHDs in the sample served county-level jurisdictions (87%; n = 543 areas). Eleven percent (n = 69) served multiple counties and so data were combined and linked at the multicounty level. The remaining 2% (n = 11) served multiple cities or were considered municipal-level LHDs—these were aggregated by averaging the data for all areas linked to the same ID in the *Profile* study.[11] As the final statistical model used the first lag of the independent variable, the outcome variables and additional covariates, observations for 2010 were dropped in the analysis, yielding data from 2011 to 2018 and 5008 observations.

Analysis

Variables were screened for outliers and descriptive statistics were computed. A time series of the primary outcome variables were inspected for potential autocorrelation and were determined to be stationary, using the Im-Pesaran-Shin test for unit roots.[31]

A pooled model using ordinary least squares (OLS) regression analysis was first estimated for comparison purposes. Next, in keeping with previous longitudinal studies focused on similar LHD factors,[6,9,12] this model was estimated using time as well as unit and year fixed effects, represented by the following:

$$\text{Outcome}_{it} = \beta_0 + \text{Outcome}_{it-1} + \text{Nurse}_{it-1}\beta_1 + X_{it-1}\beta_2 + \alpha_i + \delta_t + \varepsilon_{it}$$

where Outcome_{it} is the dependent variable measured at time t in the county for LHD i. The natural log transformation was used for the mortality outcomes as has been done in previous studies.[6,11] It can be interpreted as a percent change in the outcome for every 1-unit change in the predictor. $\text{Outcome}_{it\text{-}1}$ is the first lag of the dependent variable based on the relationship between past and current outcome values. $\text{Nurse}_{it\text{-}1}\beta_1$ represents the nurse/non-nurse lead executive and is a 1-year lag, allowing time to elapse between the lead executive presence and expected health benefits. $X_{it\text{-}1}\beta_2$ represents a 1-year lagged matrix of covariates and their coefficients, α_i represents a unit fixed effect accounting for time-invariant omitted variables (eg, regional differences), and δ_t represents year fixed effects accounting for trends. Three models were estimated for comparison for each outcome: the bivariate model; a model including covariates representing community context; and a full model including LHD organizational characteristics. The second model provided information regarding direct relationships between the nurse-led LHD and the outcomes when accounting for the social, economic, and health factors in the community. The third model additionally accounted for organizational factors through which the nurse lead executive might operate. The second and third models are presented here. All models used Arellano's[32] heteroscedastic and autocorrelation consistent variance-covariance matrix for robust standard errors. Analysis was done using R 4.0.2.

While time and unit fixed effects helped address major issues in the model, we did estimate a series of Generalized Method of Moments (GMM) models. These models were estimated using lags of potentially endogenous variables to account for additional bias due to correlation between the lagged dependent variable and error term. Results (not shown) do not substantively change the conclusions reached.

Results

Most of the lead executives in this sample were full-time, had a tenure of less than 5 years, were White, and held a master's degree or higher (see Supplemental Digital Content Table 1, available at http://links.lww.com/JPHMP/A859). For the focal predictor, 35% of LHDs had a nurse lead executive at some point over the course of the study period. Of those nurse-led LHDs, 73% changed type of leadership during the study period (n = 162), either to or from a nurse.

In examining trends of the chosen population health outcomes (not shown), very little variability exists overall in the total population, although total 15- to 44-year-old mortality increased slightly from 2010 to 2018 and more so for Black residents. Black and White infant mortality rates, as well as the percentage in the White population with late or no entry to prenatal care, changed very little from 2010 to 2018.

Table 1 provides regression results for 15- to 44-year-old mortality, demonstrating a significant relationship between nurse-led LHDs and reduced 15- to 44-year-old mortality in the Black population, as well as a reduced Black-White mortality ratio. With regard to the Black population, a significant and negative relationship exists in the pooled analysis—this relationship holds and is strengthened as combined fixed effects are added, showing that the presence of a nurse lead executive is associated with a 5.2% lower 15- to 44-year-old mortality rate in the Black population. This is similar when examining the Black-White mortality ratio. For the White population, a significant relationship is only found in the pooled models—this relationship weakens slightly with the addition of organizational covariates and disappears completely when accounting for time and unit fixed effects. When examining relationships between the nurse-led LHD and infant mortality, a significant relationship was found for the total population in the pooled analysis when community covariates were accounted for; however, this relationship did not hold with the addition of organizational covariates and fixed effects to the model (see Supplemental Digital Content Table 2, available at http://links.lww.com/JPHMP/A860).

Significant relationships exist between whether or not an LHD had a nurse lead executive and reductions in the percentage of the population with late or no entry to prenatal care (Table 2). This significant relationship also exists when looking specifically at the White population but was not found in the Black population. While no significant relationship was found in the analysis for the Black population, the coefficient size was similar to that of the White population (Black population = −0.192 ± 0.287 vs White population = −0.173 ± 0.097). Thus, the effect size is similar, but due to a smaller sample size for this specific analysis and the resulting larger standard errors, it is difficult to establish a significant relationship. As with 15- to 44-year-old mortality, this relationship held as organizational covariates were added to the model and with the addition of unit and year fixed effects. Results presented here include those LHDs with only one or no missing outcome variables over the course of the study period; subsetting the sample differently, either with LHDs with no missing outcomes or including LHDs with 2 missing outcomes, did not change the significance of the relationships.

Discussion

These findings provide evidence suggesting that the presence of a lead executive with a nursing degree is associated with improved community health outcomes. Specifically, while controlling for other factors, nurse lead executives are associated with a 5.2% lower 15- to 44-year-old mortality rate in the Black population as well as a 6% lower Black-White mortality ratio. Nurse lead executives are also associated with a reduction in the percentage of the population with late or no entry to prenatal care. These relationships hold after relevant social, demographic, health resource, and organizational variables are added to the model and after accounting for time and unit fixed effects. The relationship to reduced disparities identified here suggests that a nurse leader’s association with improved public health performance can translate into equitable health improvements.

The nurse leader’s relationship with earlier entry into prenatal care provides unique information with regard to the role of leadership. Previous studies that have included this as

an outcome have focused on the effect of either LHD program expenditures or availability of services.[33,34] Only one of these studies found a statistical relationship, which showed that certain types of LHD expenditures were associated with higher percentages of late/no entry into prenatal care.[33] In demonstrating the negative relationship between nurse lead executives and late or no entry into prenatal care, this study provides evidence on potential strategies to increase prenatal care utilization. It should be noted that while nurses lead executives were overall found to be associated with earlier entry to prenatal care in the aggregate as well as the White population specifically, no relationship was found between the nurse lead executive and this outcome in the Black population. This speaks to the importance of separating data when conducting public health systems research, as the total population-level improvement may be driven by improvements in the White population versus being shared equitably across populations. However, this may also have more to do with data availability, as certain states with large Black populations were excluded from analysis due to variations in the type of birth certificate they used.[35]

This study adds to the literature in several ways. First, few public health systems studies have examined the role of leadership with respect to community health—this study helps fill that gap. Second, the longitudinal design supported examining the effect of changes in leadership type. While Bekemeier et al[13] also had a longitudinal design, they examined clinicians as an aggregate and did not examine nurses specifically. Furthermore, their study used a first differences approach with 2 time periods as opposed to the larger number of time periods used here. Finally, this study also used additional organizational control variables not included in previous studies, such as completion of a community health assessment and board of health authority.

The association established here is fairly distant; indeed, the small effect on mortality rate and the mortality ratio speak to the multiple structural factors that influence a community's health. However, the leader of a health department is an important part of addressing such factors and who that leader is, including the values and attributes they hold, appears to matter. The findings presented here provide evidence that nurse LHD leaders appear valuable and potentially beneficial to the health of their community. Data from another study led by these authors underscore why this might be—in that study, nurses describe an "other-focused" approach to leadership and emphasized systems thinking and the importance of assessment in their work (Kett et al, unpublished data, 2021). This, along with known nursing strengths such as collaboration, planning, and problem solving,[14,16] supports the assertion that nurses are likely to be effective in the difficult work of promoting health equity.

Limitations

There are limitations in this study. First, using data from the CDC WONDER database may have influenced our inability to find a relationship between the nurse leader and infant mortality and disaggregated prenatal care outcomes, as we were unable to access county-level infant mortality data for counties with less than 250 000 population. Other studies that have found an association with public health factors and infant outcomes used state-specific birth certificate data from that state's department of health, allowing for a

more complete data set.[5,6] Gathering individual state data sets was beyond the scope of this study. Regarding prenatal care entry data, certain states' data were also excluded because of use of the 1989 version of the birth certificate. Second, specification of the models was limited by available variables; there may be additional influential time-varying factors not included. Finally, creation of a panel data set resulted in removal of more LHDs than would occur with a cross-sectional analysis; however, a conscious choice was made to utilize a longitudinal approach to allow for examination of relationship changes over time and to help account for possible unmeasured time-invariant factors. While selection bias is an issue as a result of the panel design and choice of outcome, the distribution of small, medium, and large LHDs in the sample is similar to that of the LHD respondents for each *Profile* study.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Implications for Policy & Practice

- The current COVID-19 pandemic highlights significant inequities in health in our country—inequities due largely to systems that create differential opportunity and access. Research is needed to understand factors that support more effective public health systems that can respond to immediate needs in communities.
- This study provides valuable information regarding the role and contribution of nurse lead executives to such a system. Specifically, the evidence presented here suggests that employing nurses to lead public health departments may facilitate local prevention efforts to effectively address health inequities.
- Continued research is needed that focuses on public health strategies to address inequitable health outcomes, as well as how to best employ nurse leaders in supporting this work.

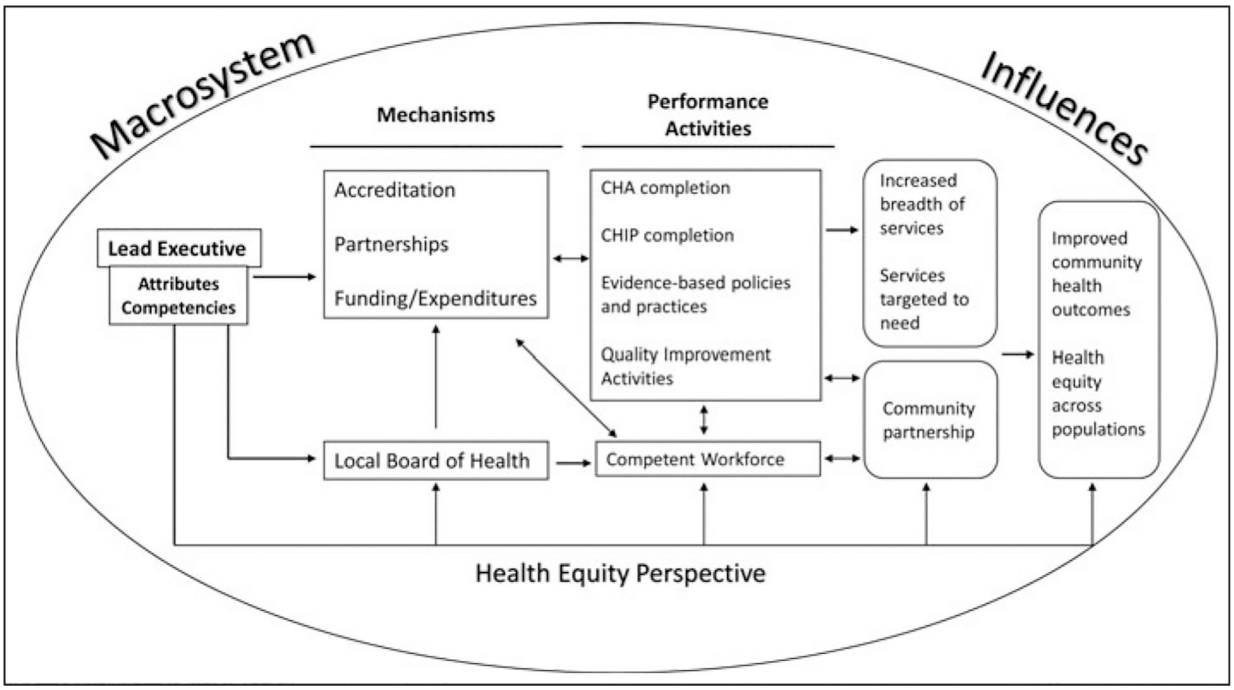

FIGURE.

Pathway to Community Health Conceptual Model Demonstrating the Factors and Mechanisms Leveraged by the Lead Executive in Supporting Improved Health in the Community

Abbreviations: CHA, community health assessment; CHIP, community health improvement plan.

TABLE 1

Relationship Between the LHD Nurse Lead Executive and 15- to 44-Year-Old Mortality, 2010–2018[a]

	ln(15–44 Mortality)															
	Total (N = 626)				Black (N = 142)				White (N = 556)				Mortality Ratio (N = 142)			
	Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed	
Variables	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**
Lead executive is a nurse	− 0.007	− 0.008	0.008	0.011	− 0.019	− 0.031[b]	− 0.037[c]	− 0.052[b]	− 0.013[b]	− 0.012[b]	0.005	0.010	− 0.016	− 0.020	− 0.044[c]	− 0.060[b]
Community characteristics																
Disadvantage index	0.014[d]	0.015[d]	− 0.009	− 0.009	0.018[d]	0.021[d]	− 0.032[c]	− 0.039[b]	0.014[d]	0.014[d]	− 0.017[b]	− 0.017[b]	0.021[d]	0.029[d]	0.005	− 0.003
% age ≤19 y	0.003[b]	0.002	− 0.011[c]	− 0.011[b]	0.004	0.001	− 0.000	0.004	0.003[c]	0.002	− 0.016[d]	− 0.016[d]	− 0.006	− 0.007	0.018	0.024
% age ≥65 y	0.010[d]	0.010[d]	0.009	0.012[c]	0.010[d]	0.011[d]	− 0.009	− 0.001	0.010[d]	0.010[d]	− 0.001	0.000	− 0.007[b]	− 0.007[d]	− 0.023	− 0.018
% persons <65 y who are uninsured	− 0.002[d]	− 0.003[d]	0.003	0.004	− 0.004[d]	− 0.005[d]	0.012[d]	0.015[d]	− 0.003[d]	− 0.003[d]	0.005[b]	0.006[b]	− 0.001	− 0.003[c]	− 0.001	0.001
ln(Providers per 1000 population)	− 0.021[d]	− 0.02[d]	0.019	0.001	0.031[c]	0.035[b]	0.094	− 0.049	− 0.032[d]	− 0.031[d]	0.052	0.026	0.094[d]	0.119[d]	0.046	− 0.142
% Black	0.001[d]	0.001[d]	X	X	0.001[d]	0.001[d]	X	X	0.001[d]	0.001[d]	X	X	0.000	0.000	X	X
% Hispanic	− 0.001[d]	− 0.001[d]	X	X	− 0.001[b]	− 0.000	X	X	− 0.001[d]	− 0.001[d]	X	X	0.001	0.001	X	X
Rural-urban classification																
Metropolitan	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Micropolitan	0.013[b]	0.010	X	X	0.070[d]	0.073[d]	X	X	0.017[b]	0.016[b]	X	X	0.027	0.069	X	X
Rural	0.054[d]	0.054[d]	X	X	0.148	0.178[c]	X	X	0.052[d]	0.053[d]	X	X	0.081	0.165	X	X
LHD characteristics																
Board of health has policy-making authority		− 0.006		0.012		0.030[b]		0.052[c]		− 0.002		0.003		0.003		0.044
Total # of FTEs		0.000[d]		− 0.000		− 0.000[b]		− 0.000[c]		− 0.000[c]		− 0.000		− 0.000		− 0.000
Completed CHIP within the last 3 y		− 0.009[c]		− 0.010		0.013		0.060[d]		− 0.012[b]		− 0.013[c]		0.025[c]		0.072[d]
Completed CHA within the last 3 y		0.003		0.014[c]		− 0.007		− 0.013		0.009		0.017[b]		− 0.016		− 0.010
Services provided																
Maternal and child health		− 0.003[b]		− 0.002		− 0.001		0.001		− 0.004[d]		− 0.005		− 0.002		− 0.008
Immunizations		− 0.006		0.006		− 0.003		0.002		− 0.006		0.007		− 0.002		0.006

	ln(15–44 Mortality)															
	Total (N = 626)				Black (N = 142)				White (N = 556)				Mortality Ratio (N = 142)			
	Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed	
Variables	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**
Screening		0.003[b]		− 0.003		0.005[c]		0.001		0.002		− 0.003		0.010[d]		0.006
Treatment		0.003		0.000		0.001		0.005		0.005		0.005		− 0.008		− 0.014
Other health services		− 0.003		0.008[c]		− 0.008[b]		− 0.002		− 0.002		0.007[c]		− 0.005		− 0.010
Epidemiology and surveillance		− 0.002		− 0.002		− 0.001		0.003		− 0.003[c]		− 0.002		− 0.005		0.010[b]
Population-based primary prevention		− 0.001		0.002		− 0.000		− 0.000		− 0.001		0.003[c]		0.000		− 0.001
Regulation, inspection, and/or licensing		0.001		− 0.001		− 0.000		− 0.004		0.003[d]		− 0.000		− 0.006[b]		− 0.004
Environmental health		− 0.002[b]		0.000		− 0.002		− 0.001		− 0.003[d]		− 0.001		− 0.003		− 0.001
Other population-based services		− 0.001		− 0.001		− 0.003		0.001		− 0.002		− 0.00		0.003		− 0.000
Dependent variable lag	0.756[d]	0.740[d]	0.004	− 0.0158	0.737[d]	0.710[d]	− 0.015	− 0.040	0.741[d]	0.731[d]	0.017	− 0.004	0.587[d]	0.544[d]	− 0.017	− 0.029

Abbreviations: CHA, community health assessment; CHIP, community health improvement plan; FTE, full-time equivalent; LHD, local health department.

[a]Results of the time series analysis focused on the relationship between the type of lead executive and 15- to 44-year-old mortality outcomes. Infant mortality results are not shown due to the absence of a significant relationship found in the final analysis.

[b]P < *.05.*

[c]P < *.1.*

[d]P < *.01.*

TABLE 2

Relationship Between the LHD Nurse Lead Executive and Prenatal Care Entry, 2010–2018[a]

	Late or No Prenatal Care, %															
	Total (N = 280)				Black (N = 194)				White (N = 280)				PNC Ratio (N = 194)			
	Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed	
Variables	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**
Lead executive is a nurse	− 0.139[b]	−0.110	− 0.193[b]	− 0.207[b]	−0.165	−0.163	−0.276	−0.192	− 0.134[b]	− 0.116	− 0.179[b]	−0.173[c]	0.038	0.032	0.040	0.074
Community characteristics																
Disadvantage index	− 0.075[d]	− 0.087	− 0.149	− 0.111	− 0.106[b]	− 0.136[d]	− 0.344[b]	− 0.279	− 0.080[d]	− 0.091[d]	− 0.168[c]	− 0.135	0.005	0.005	0.016	0.001
% age ≤ 19 y	− 0.008	− 0.0054	− 0.093	− 0.100[c]	0.028	− 0.023	− 0.191[c]	− 0.217[c]	− 0.007	− 0.004	− 0.063	− 0.073	0.010	0.004	0.002	− 0.006
% age ≥65 y	0.019[b]	0.026[d]	0.063	0.057	0.000	0.014	− 0.134	− 0.156	0.022[d]	0.028[d]	0.051	0.047	− 0.007	− 0.008[b]	− 0.031	− 0.018
% persons <65 y who are uninsured	0.032[d]	0.034[d]	− 0.020	− 0.037	0.048[dd]	− 0.055[d]	0.011	− 0.031	0.035[d]	0.037[d]	− 0.016	− 0.034	− 0.007[b]	− 0.007[c]	0.000	− 0.003
ln(Providers per 1000 population)	− 0.178[d]	− 0.171[d]	1.809[c]	1.69[c]	− 0.100	− 0.156[c]	5.464[d]	5.68[b]	− 0.245[d]	− 0.235[d]	1.398	1.36	0.087[d]	0.083[d]	− 0.046	0.143
% Black	0.032[d]	0.035[d]	X	X	0.0158[d]	0.020[d]	X	X	0.024[d]	0.027[d]	X	X	− 0.004[b]	− 0.004[b]	X	X
% Hispanic	0.010[d]	0.014[d]	X	X	− 0.008[c]	− 0.007	X	X	0.011[d]	0.016[d]	X	X	− 0.006[d]	− 0.006[d]	X	X
Rural-urban classification																
Metropolitan	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Micropolitan	0.152	0.258[c]	X	X	− 0.610	− 0.426	X	X	0.188	0.301[b]	X	X	− 0.0157[d]	− 0.155[b]	X	X
Rural	1.005[d]	1.000[d]	X	X	n/a[e]	n/a[e]	X	X	1.009[d]	1.018[d]	X	X	n/a[e]	n/a[e]	X	X
LHD characteristics																
Board of health has policy-making authority		0.179[d]		0.042		0.296[b]		0.064		0.169[d]		0.068		0.011		0.031
Total # of FTEs		− 0.000		− 0.000		0.000		− 0.000		− 0.000[c]		− 0.000		0.000		− 0.000
Completed CHIP within the last 3 y		− 0.025		− 0.099		− 0.126		− 0.428[b]		− 0.011		− 0.082		0.032		0.013
Completed CHA within the last 3 y		0.012		0.048		− 0.087		− 0.015		0.04		0.069		− 0.090[d]		− 0.072
Services provided																
Maternal and child health		− 0.020		− 0.058[c]		− 0.047		− 0.105[c]		− 0.014		− 0.056[c]		− 0.002		0.018
Immunizations		− 0.028		0.063		− 0.059		0.030		− 0.029		0.059		0.019		− 0.040

	Late or No Prenatal Care, %															
	Total (N = 280)				Black (N = 194)				White (N = 280)				PNC Ratio (N = 194)			
	Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed		Pooled		Time and Unit Fixed	
Variables	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**	**Community**	**Full**
Screening		− 0.010		− 0.024		− 0.029		− 0.021		− 0.007		− 0.024		− 0.003		− 0.002
Treatment		0.052		− 0.009		0.167[b]		0.163		0.045		− 0.029		0.021		0.026
Other health services		0.025		0.006		− 0.007		− 0.048		0.022		0.022		− 0.013		− 0.032[c]
Epidemiology and surveillance		0.016		0.011		− 0.001		− 0.025		0.023		0.011		− 0.012		− 0.003
Population-based primary prevention		− 0.023[c]		− 0.012		− 0.017		0.030		− 0.021[c]		− 0.009		0.003		0.009
Regulation, inspection, and/or licensing		− 0.007		− 0.010		− 0.032[c]		− 0.027		− 0.005		− 0.004		− 0.009[c]		− 0.006
Environmental health		0.15		0.024		0.036		0.072[b]		0.012		0.018		0.008		0.004
Other population-based services		0.011		0.024		0.011		0.005		0.006		0.033		0.007		0.003
Dependent variable lag	0.750[d]	0.741	0.437[d]	0.425[d]	0.754[d]	0.742[d]	0.370[d]	0.354[d]	0.742[d]	0.733[d]	0.401[d]	0.386[d]	0.659[d]	0.649[d]	0.097[c]	0.088[c]

Abbreviations: CHA, community health assessment; CHIP, community health improvement plan; FTE, full-time equivalent; LHD, local health department; MCH, maternal and child health; PNC, prenatal care.

[a]Results of the time series analysis focused on the relationship between the type of lead executive and entry into prenatal care. Infant mortality results are not shown due to absence of a significant relationship found in the final analysis.

[b]P < *.05.*

[c]P < *.1.*

[d]P < *.01.*

[e]Not present in this sample.