

Associations Between Local Health Department Maternal and Child Health Programs and
Low Birth Weight in Rural Communities

by

Krista Cowan

Introduction

On a national scale, the supply of physicians decreases as the area's rurality increases.¹ This shortage of physicians forces people to travel farther to obtain their necessary services. Therefore, Local Health Departments (LHDs) play a critical role in providing health services to those in need. One area regularly addressed by LHDs is Maternal and Child Health (MCH). Women and Children's Health Services include programs such as WIC (the special supplemental nutrition program for Women, Infants, and Children), family planning, Maternal and Child Health home visits, EPSDT (Early Periodic Screening, Diagnosis, and Treatment), prenatal care, obstetric care, and well child care. It is important that pregnant women have nearby access to these services because when women travel to obtain healthcare, they are much less likely to obtain adequate prenatal care due to compliance.² This is especially true for women in rural, high outflow communities, who generally have the highest rates of prematurity.³

In each community, these MCH services can be provided directly by the LHD; the health department can contract the service to another provider; a provider can offer the service independently; or the service may not be provided by anyone in the region. Despite a decreased number of physicians in rural communities, from 2005 to 2010, a smaller percentage of LHDs' total expenditures has been used to support MCH services.⁴ Therefore, it is imperative to determine which programs are the most effective at generating positive health outcomes for the community so that scarce resources can be distributed most effectively.

One measure of children's health is birth weight, which is the weight of the child immediately after birth.⁵ A low birth weight (LBW) is defined as any weight below 2500 grams (5.5lbs). LBW is one of the leading causes of neonatal death,⁶ and is associated with the development of coronary heart disease,⁷ diabetes,⁸ childhood hypertension,⁹ behavioral

disorders,¹⁰ and psychological disorders.¹¹ Generally, mothers residing in rural areas have a greater chance of having a child with a low birth weight.¹² This could be because of the relative low availability of MCH programs in the area. This study uses a cross-sectional design to examine the hypothesis that the presence of MCH programs in rural counties is associated with a lower percent of low birth weight infants.

Methods

This study utilized data from the National Association of County and City Health Officials' (NACCHO's) 2013 National Profile of Local Health Departments Study.¹³ This survey was completed by directors of LHDs and received 2,000 responses from an estimated total of 2800 LHDs in the United States.¹⁴ One question on the survey addressed MCH programs and how they were delivered to the community.¹³ It assessed the presence of family planning, prenatal care, obstetrical care, WIC, MCH home visits, EPSDT, and a well child care. LHDs were allowed to check multiple options that corresponded to how the community received these services: "performed by LHD directly," "contracted out by LHD," "provided by others in community independent of LHD-funding," "not available in community," or "don't know." Because more than one service delivery option could be selected for a single program, a score was generated for each program using two different methods. In the first method, the program was assigned a score of 3 points if the MCH service was "performed by LHD directly," 2 points if the service was "contracted out by LHD," 1 point if the service was "provided by others in community independent of LHD-funding," and zero points if the service was "not available in community" or the "don't know" boxes were checked. These points were then summed to give a total score ranging between 0 and 6 for each service. The points are weighted in this way,

because it is believed that LHD involvement in each program leads to the program being more tailored to the needs of the local population. The points for all the 7 possible MCH programs were also summed to create an overall MCH score that ranged from 0 to 42.

A second method of calculation was also used that speculated that the entity providing the service did not affect the quality of the service. Therefore, 1 point was given for each box checked labeled “performed by LHD directly,” “contracted out by LHD,” or “provided by other in community independent of LHD-funding.” No points were given if the community did not have the service or if the LHD did not know if the service was provided. On this scale, each individual program could have a score between 0 and 3, while the overall MCH score theoretically ranged from 0 to 21.

The study was limited to LHDs serving a single county jurisdiction, thus excluding LHDs serving only towns, cities, or multiple counties. In addition to the NACCHO data, LHDs were assigned Rural-Urban Commuting Area (RUCA) codes, based on the 2000 Census commuting data and the zip codes of 2004.¹⁵ RUCA codes can be grouped into four major categories. The first is Urban focused which includes RUCA codes 1.0, 1.1, 2.0, 2.1, 3.0, 4.1, 5.1, 7.1, 8.1, and 10.1. The second is Large Rural City/Town focused which encompasses RUCA codes 4.0, 4.2, 5.0, 5.2, 6.0, and 6.1. The Small Rural Town focused group includes RUCA codes 7.0, 7.2, 7.3, 8.0, 8.2, 8.3, 8.4, 9.0, 9.1, and 9.2. The category of Isolated Small Rural Town focused contains RUCA codes 10.0, 10.2, 10.3, 10.4, 10.5, and 10.6. Using the RUCA code subdivisions allows one to examine where people living in these counties generally commute. This serves as a predictor of where people receive their health services. Finally, the percentage of low birth weight infants of each county was obtained from the 2014 National County Health Rankings provided by the Robert Wood Johnson Foundation.¹⁶ These data were then analyzed in Stata

(version 12.1) using t-tests and linear regressions to generate this study's findings. The percentage of low birth weight infants was used as the dependent variable for all analyses. MCH scores – by program and using overall MCH scores – served as the independent variables. Linear regressions compared the overall MCH score or an individual program's score for the entire sample, as well as subgroup analyses based on RUCA area, with the percentage of low birth weight infants. Additionally, differences in the percentage of low birth weight infants based on the presence of a specific MCH program that was provided directly by the LHD versus MCH programs available through other providers or not provided was examined using unpaired t-tests.

Results

After limiting the study to LHDs serving only single county jurisdictions, the study included 1441 LHDs. In this study, urban focused counties with LHDs made up 32.2% of the total set. Large rural town or city focused counties made up 21.1%, small rural town focused counties made up 26.3%, and isolated small rural town focused counties made up 20.4% (Table 1).

The program and overall MCH score was initially calculated using the weighted scale of method one, which assumes LHD involvement provides a benefit to the program. Table 2 shows that the total MCH score from all ruralities correlates positively with low birth weight; thus LHD involvement in MCH programs was associated with higher percentage of low birth weight infants. Family planning services were associated with a higher percentage of low birth weight infants, a relationship that held true for the counties overall and by RUCA subdivisions. Higher obstetric care scores were related to a higher percentage of infants born with low birth weight in counties overall and in small rural town

focused counties. Similarly, WIC was associated with a higher percentage of low birth weight infants in counties overall, in small rural town focused communities, as well as in isolated small rural town focused counties. Availability of home visits was related to a lower percentage of infants born with low birth weight overall and across all RUCA subdivisions, although statistical significance was not reached in the small rural town focused counties.

Table 3 shows the t-values of linear regressions between low birth weight and each program's overall score and the total MCH score for the entire sample, and by RUCA subgroups. These scores are calculated using method two, which assumes the provider delivering the service has no impact on the program's effectiveness. The results show that overall and in the RUCA division of Urban focused areas, family planning has a positive association with the percentage of infants born with low birth weight. This means that a greater family planning score, which occurs due to more providers offering this program, is associated with a higher percentage of babies being born with a low birth weight. In small rural town focused counties, higher obstetric care scores were related to a higher percentage of low birth weight infants. In isolated small rural town focused counties, higher WIC scores were associated with a higher percentage of infants born with low birth weight, while the presence of a well child clinic was related to a lower percentage of infants having low birth weight. Home visits were associated with a lower percentage of low birth weight infants across all the RUCA subdivisions and overall, but only reached statistical significance in the overall, urban focused areas, and isolated small rural town focused communities.

Finally, unpaired t-tests were performed to compare the percentage of low birth weight infants based on the provider of a specific MCH program (LHD versus other providers or not at all)(Table 4). The results showed that a family planning program provided directly by the LHD had a significant, negative association with the percentage of low birth weight infants in the county across all levels of rurality and each RUCA subdivision. Obstetric care provided by the LHD also had a negative association with the percentage of low birth weight infants overall, in urban focused counties, small rural town focused counties, and isolated small rural town focused counties. When WIC was directly provided, only in small rural town focused counties and overall was there a significant, negative association with the percentage of low birth weight infants. LHDs that directly provided home visits had positive associations with low birth weight overall, in urban focused areas, large rural town or city focused areas, and in isolated small rural town focused areas.

Discussion

After examining the data, home visits programs were found to be most often associated with a lower percentage of infants born with low birth weights, especially in small rural communities. In contrast, other programs such as WIC and family planning have positive associations with the percentage of low birth weight infants, which meant that counties with these programs were more likely to have a greater percentage of infants born under 5.5lbs. Therefore, the presence of MCH programs in rural communities is not necessarily associated with a lower percentage of low birth weight infants as previously speculated.

The variance between different MCH programs and the percentage of low birth weight infants is possible due to cross-sectional study design. Because this study uses data at a set point in time, there is no way to determine causality between the two variables. This reverse causality could mean that the MCH program's establishment increased or decreased the percentage of low birth weight infants. It is possible that the program lowered the percentage of low birth weights by providing the mothers with care or counseling needed to increase the child's weight in utero. In contrast, the program's establishment may have increased the percentage of low birth weight infants in the county. The mother's enrollment in the program may increase the incidence of low birth weight infants in the population. This occurs because the program's records may be documenting cases of low birth weight infants that would not have been previously recorded due to a previous lack of MCH services. There also may not have had any effect on the low birth weight percentages of the county. Mothers may not have enrolled in the program early enough to reduce the incidence of low birth weight infants. The program's specific components, which are not specified in each county, may be targeted at mother and children after birth, which would not affect the infant's birth weight. In addition, the availability of the program does not reflect the program's actual use by pregnant women. The other possibility of causality is that the percentage of low birth weights in the county affects the establishment or termination of the MCH programs. A county with a large amount of low birth weight infants may choose to enact a MCH program not currently established. This would show a positive association between the MCH program's score and the percentage of infants with low birth weights. Alternatively, if a county has very few infants being born with low birth weight, they may chose to allot their funding to different

programs and terminate the program. This would reflect a negative association between the MCH program's score and the percentage of low birth weight infants in the county. The many different scenarios of causality offer possible explanations for the variance amongst MCH programs' scores and their association with the percentage of low birth weight infants in the county. A retrospective longitudinal design should be used in future studies to examine the potential causal relationship between the percentage of low birth weight infants and the MCH program's score.

This study shows a variance between the MCH programs' associations with the percentage of LBW infants across different RUCA divisions. Rurality may contribute to effectiveness of the MCH program. Rural communities generally have higher poverty rates and a larger percentage of the population uninsured than their urban or suburban counties.¹ Lack of money and insurance for MCH services may be underlying, confounding factors that may skew the data. If a mother cannot afford the care, she is more likely to have a child under 5.5lbs, resulting in a greater percentage of children in the county with low birth weights. In addition, rural communities generally lack effective public transportation systems like urban communities. This is another reason that mothers in rural counties may not be able to utilize the MCH services available. In addition, it is important to consider that adolescents and adults in rural areas are more likely to be smokers than their urban counterparts, which predisposes their children to low birth weights.¹ This could be a potential confounding variable that makes rural counties generally have a greater percentage of low birth weights infants than urban counties. Rurality is a contributing factor to the association between MCH program scores and the percentage of LBW infants because it reflects variations between the populations in these areas, including economic

and physical limitations to accessing health care and health practices that may contribute to the percentage of LBW infants.

The provider of the service also seemed to have an effect on the association between the MCH program's score and the percentage of LBW infants in the county. When comparing the two scoring systems, method 1 and method 2, the associations were generally either positive in both methods or negative in both methods. Despite this, differences were seen when the MCH programs provided directly by the LHD were compared to those with services provided by others independently, contracted to others by the LHD, or not provided at all. For example, home visits in rural counties showed a strong negative association with low birth weight when scores using method 1 and method 2. In contrast, home visits programs provided directly by LHDs had a positive association to the percentage of LBW infants compared to home visits provided by any other party or not at all. The positive association between the MCH program provided directly by the LHD possibly indicates that the LHD has recently established this program to reduce the percentage of LBW infants, although this cannot be confirmed without a longitudinal study to determine causality. In addition, family planning and obstetric care provided directly by LHDs was associated with a lower percentage of low birth weight infants. These services may be more specialized to the community's needs because they are provided by the LHD as opposed to another provider. Generally, the provider of the program seems to have some effect on the association between the MCH program's score and the county's percentage of LBW infants, although this variance may be due to the recent establishment of a program instead of more effective services.

When analyzing the data, it is important to acknowledge some of the limitations in this study. First, the data from the questionnaire were self reported, which makes the accuracy

of the data difficult to verify. For example, the director the LHD may not definitively know which third parties are providing a specific MCH service. Second, the sample size of the data is also quite small and limited to only county data. The small quantity allows for outlying variables to considerably skew the data. Third, there may have been other confounding variables that were also not included in the analyses, including race, the mother's current health conditions, and the mother's smoking status. These three factors can predispose the infant to have a low birth weight. Fourth, the economic status of the mother and the availability of transportation to the MCH service were also not considered. These might contribute to the type and frequency of MCH services used by mothers. Finally, the cross sectional design of this study does not allow causality between the MCH program's presence and the percentage of LBW infants to be determined. All of these limitations were considered while analyzing the data from this study.

Conclusion

Overall, this study offers data about the associations between the percentage of low birth weight infants and the presence of MCH programs provided in these counties. It found that a greater home visits score most often associated with a smaller percentage of low birth weights in the county. Despite this association, the cross sectional study design cannot indicate causality between the program's presence and the percent of LBW infants. Ruralness is shown to contribute to the association between MCH programs and the percent of LBW infants. This may be to the differences in poverty, transportation, and smoking status in mothers in rural counties compared to urban counties. It supports that the provider affects the association between the county's percentage of LBW infants and the MCH program's score. Although the original hypothesis was

not supported, the study showed that rurality and providers affect associations between MCH programs and the percentage of LBW infants.

Tables

Table 1. Percentage of Local Health Departments in Each Rurality Classification

Rurality	Frequency	Percent	Cumulative Percent
Urban Focused	464	32.20	32.20
Large Rural Town or City Focused	304	21.10	53.30
Small Rural Town Focused	379	26.30	79.60
Isolated Small Rural Town Focused	294	20.40	100.00
Total	1,441	100.00	

Table 2. Association between Maternal and Child Health Scores and Low Birth Weight, using Method 1 scoring. (Each Program's Score Correlated with Percentage of Low Birth Weight Infants and Scored via Method 1 so that the Programs Provided Directly by the LHD are of Higher Value than Those Contracted, Which are more than Those Provided Independently by Other Organizations)

Program	t-values				
	All Ruralities	Urban Focused	Large Rural Town or City Focused	Small Rural Town Focused	Isolated Small Rural Town Focused
Maternal and Child	2.05*	1.15	1.46	1.73	-0.40
Family Planning	6.85**	4.03**	3.42**	4.02**	2.36*
Prenatal Care	1.28	-0.85	0.55	1.86	0.72
Obstetric Care	3.86**	1.43	1.64	3.57**	0.98
WIC Score	2.82**	1.09	-0.12	2.38*	2.16*
Home Visits	-5.69**	-3.21**	-2.53*	-1.71	-4.60**
EPSDT	0.76	1.36	1.03	0.06	-0.86
Well Child Clinic	0.60	0.45	1.68	0.06	-0.93

*P value <0.05, **P value <0.01

Table 3. Association between Maternal and Child Health Scores and Low Birth Weight, using Method 2 scoring. (Each Program's Score Correlated with Percentage of Low Birth Weight Infants and Scored via Method 2 so that the Programs Provided Directly by the LHD, Contracted Out by the LHD, or Independently Provided have Equal Value.)

Program	t-values				
	All Ruralities	Urban Focused	Large Rural Town or City Focused	Small Rural Town Focused	Isolated Small Rural Town Focused
Maternal and Child	0.43	0.13	0.60	0.62	-1.02
Family Planning	3.04*	2.13*	1.11	0.99	1.68

Prenatal Care	-0.11	-1.75	0.06	1.20	-0.33
Obstetric Care	1.64	0.41	1.11	1.98*	-0.69
WIC Score	0.90	-0.87	0.70	0.36	2.72**
Home Visits	-3.39**	-1.98*	-1.86	-0.66	-3.59**
EPSDT	0.67	1.51	0.53	-0.39	-0.42
Well Child Clinic	-0.02	-0.18	1.20	0.69	-2.01*

*P value <0.05, **P value <0.01

Table 4. The Associations between the Percentage of Low Birth Weight Infants and MCH Programs Directly Provided by the LHD as Opposed to those Provided by Any Other Method or Not at All

Directly Provided Program by the LHD	t-values				
	All Ruralities	Urban Focused	Large Rural Town or City Focused	Small Rural Town Focused	Isolated Small Rural Town Focused
Family Planning	-8.31**	-4.4209**	-4.5081**	-5.5372**	-2.4069*
Prenatal Care	-1.60	0.5349	-0.4802	-1.7900	-1.2767
Obstetric Care	-3.87**	-1.3196	-1.0878	-3.4446**	-2.1183*
WIC	-3.05**	-1.3532	0.4702	-2.9497**	-1.8963
Home Visits	6.098**	3.5946**	2.5776*	1.8917	4.3351**
EPSDT	-0.806	-0.9985	-1.1751	-0.5589	0.9273
Well Child Clinic	-0.8189	-0.6450	-1.6098	0.2010	0.2166

*P value <0.05, **P value <0.01

References

1. Meit M, Knudson A, Gilbert T, Yu AT, Tanenbaum E, Ormson E, TenBroeck S, Bayne A, Popat S, NORC Walsh Center for Rural Health Analysis. Rural Health Reform Policy Research Center. *The 2014 update of the rural-urban chartbook*. October 2014. Available at <http://ruralhealth.und.edu/projects/health-reform-policy-research-center/pdf/2014-rural-urban-chartbook-update.pdf>, Accessed December 8 2014.
2. McDonald TP, Coburn AF. Predictors of prenatal care utilization. *Soc Sci Med*.1988; 27(2): 167-72. Available <http://www.ncbi.nlm.nih.gov/pubmed/3051419>, Accessed December 9 2014.
3. Nesbitt TS, Connell FA, Hart LG, Rosenblatt RA. Access to obstetric care in rural areas: effect on birth outcomes. *Am J Public Health*. 1990;80(7):814-8. Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1404977>, Accessed December 9 2014.
4. Bekemeier B, Dunbar M, Bryan M, Morris ME. Local health departments and specific maternal and child health expenditures: relationships between spending and need. *J Public Health Manag Pract*. 2012;18(6):615-22. Available http://journals.lww.com/jphmp/Abstract/2012/11000/Local_Health_Departments_and_Specific_Maternal_and.18.aspx, Accessed December 9 2014.
5. U.S. National Library of Medicine. Medline Plus. *Birth weight*. Available <http://www.nlm.nih.gov/medlineplus/birthweight.html>, Accessed December 8 2014.

6. Lawn JE, Cousens S, Zupan J. 4 million neonatal deaths: when? Where? Why?. *Lancet*. 2005;365(9462):891-900. Available <http://www.ncbi.nlm.nih.gov/pubmed/15752534>, Accessed December 10 2014.
7. Leon DA, Lithell HO, Vâgerö D, Koupilová I, Mohsen R, Berglund L, Lithell UB, McKeigue PM. Reduced fetal growth rate and increased risk of death from ischaemic heart disease: cohort study of 15000 Swedish men and women born 1915-29. *BMJ*. 1998 Jul 25; 317(7153):241-5. Available <http://www.ncbi.nlm.nih.gov/pubmed/9677213>, Accessed December 10 2014.
8. Leger J, Levy-marchal C, Bloch J, et al. Reduced final height and indications for insulin resistance in 20 year olds born small for gestational age: regional cohort study. *BMJ*. 1997;315(7104):341-7. Available <http://www.ncbi.nlm.nih.gov/pubmed/9270455>, Accessed December 10 2014.
9. Forrester TE, Wilks RJ, Bennett FI, Simeon D, Osmond C, Allen M, Chung AP, Scott P. Fetal growth and cardiovascular risk factors in Jamaican schoolchildren. *BMJ*. 1996 Jan 20; 312(7024):156-60. Available <http://www.ncbi.nlm.nih.gov/pubmed/8563535>, Accessed December 10 2014.
10. Schothorst PF, van Engeland H. Long-term behavioral sequelae of prematurity. *J Am Acad Child Adolescent Psychiatry*. 1996 Feb; 35(2):175-83. Available <http://www.ncbi.nlm.nih.gov/pubmed/8720627>, Accessed December 10 2014.

11. Olsén P, Vainionpää L, Pääkkö E, Korkman M, Pyhtinen J, Järvelin MR. Psychological findings in preterm children related to neurologic status and magnetic resonance imaging. *Pediatrics*. 1998 Aug; 102(2 Pt 1):329-36. Available <http://www.ncbi.nlm.nih.gov/pubmed/9685434>, Accessed December 10 2014.
12. Kayode GA, Amoakoh-coleman M, Agyepong IA, Ansah E, Grobbee DE, Klipstein-grobusch K. Contextual risk factors for low birth weight: a multilevel analysis. *PLoS ONE*. 2014;9(10):e109333. Available <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0109333>, Accessed December 9 2014.
13. NACCHO. *2013 Profile of Local Health Departments Study*.
14. NACCHO. *2013 National Profile of Local Health Departments*. Jan. 2014. Available <http://www.naccho.org/topics/infrastructure/profile/upload/2013-National-Profile-of-Local-Health-Departments-report.pdf>, Accessed December 8 2014.
15. WWAMI. RUCA: Rural Health Research Center. *RUCA Data*. Available <http://depts.washington.edu/uwruca/ruca-uses.php>, Accessed December 7 2014.
16. Robert Wood Johnson Foundation. 2014 County Health Rankings National Data. *County Health Rankings & Roadmaps*. Available <http://www.countyhealthrankings.org/rankings/data>, Accessed December 7 2014.