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Where Is Obesity Prevention on the Map? Distribution and Predictors of Local Health Department Prevention Activities in Relation to County-Level Obesity Prevalence in the US

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Abstract

Context—The system of local health departments (LHD) in the US has potential to advance a locally-oriented public health response in obesity control and reduce geographic disparities. However, the extent to which obesity prevention programs correspond to local obesity levels is unknown.

Objective—This study examines the extent to which LHDs across the US have responded to local levels of obesity by examining the association between jurisdiction level obesity prevalence and the existence of obesity prevention programs.

Design—Data on LHD organizational characteristics from the Profile Study of Local Health Departments and county-level estimates of obesity from the Behavioral Risk Factor Surveillance System were analyzed (n=2,300). Since local public health systems are nested within state

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infrastructure, multilevel models were used to examine the relationship between county-level obesity prevalence and LHD obesity prevention programming and to assess the impact of state-level clustering.

Setting—2,300 local health department jurisdictions defined with respect to county boundaries

Participants—Practitioners in local health departments who responded to the 2005 Profile Study of Local Health Departments.

Main Outcome Measures—Likelihood of having obesity prevention activities and association with area-level obesity prevalence

Results—The existence of obesity prevention activities was not associated with prevalence of obesity in the jurisdiction. A substantial portion of the variance in LHD activities was explained by state-level clustering.

Conclusions—This paper identified a gap in the local public health response to the obesity epidemic and underscores the importance of multilevel modeling in examining predictors of LHD performance.

MeSH Keywords

Obesity; Primary Prevention; Community Health Services; Public Health Practice; Multilevel Analysis; Geographic Information Systems

Introduction

The shift in the weight distribution of the US population over the past 30 years,[1] along with the burden of ill health and economic costs of obesity,[2] represents a great challenge to public health. Given the rapidity of the shift, it appears that modifiable factors (e.g., physical activity, diet) are likely more important determinants of the current obesity crisis than non-modifiable factors (e.g., genetics).[3]

While the challenge is nearly ubiquitous, there is a great deal of variation in the prevalence of obesity across geographic localities in the US, underscoring the importance of a locally-oriented public health response in obesity control. [4–7] In 2007, obesity prevalence ranged from 12% to 44% across US counties. [8] Identifying characteristics of localities and local infrastructure associated with area obesity rates could provide valuable insights for future interventions at the local level and help reorient prevention into areas which offer the potential for population-wide impact. [9] The most promising evidence-based interventions for population-based obesity control[10–14] are not being implemented widely enough to impact obesity rates,[15] or to alleviate disparities defined by socioeconomic status, race/ethnicity or geographic locality.[5, 16, 17]

Local health departments (LHD) can play an important role in the widespread application of evidence-based programs and policies to prevent obesity, though this has not traditionally been an area of programmatic focus for many LHDs, with only 56% reporting any obesity prevention activities in 2005.[18] However, LHDs are uniquely positioned to improve implementation of obesity prevention efforts in underserved areas in several ways: by institutionalizing evidence-based practice at the local level,[19–21] cultivating community advocacy and partnerships,[22] and adapting and developing programs and policies to the unique context of their communities that may influence their effective application over time.[23, 24] Unfortunately, local public health agencies have struggled to meet this challenge with respect to obesity and other chronic disease prevention programming.[25]

There are a number of factors that may influence the ability of LHDs to implement evidence-based practice in general, and obesity prevention practice in particular (Figure 1).[19, 26] First is the prioritization of obesity prevention in the local community, which may be informed not only by local obesity rates, but also by competing or overlapping priorities, and local values, preferences and culture. Second, organizational characteristics of the LHD itself may relate to the capacity to implement obesity prevention in particular or services in general. Current activities in related program areas (e.g., tobacco control[27], WIC[28]) and having specialized staff may offer avenues for extending current practice to include obesity prevention, while the size of population served[29] and expenditures per capita are broad-reaching performance drivers.[30–32] Third is the ability to apply the best available evidence for obesity prevention by adapting it to the local context.[33] Areas of overlap between each domain may be defined as the level of integration and congruence between the capacity, needs and priorities of each domain. Finally, the first three domains are nested within the higher-level environmental and organizational context within which the LHD operates (e.g., state vs. local governance). [34]

The system of LHDs in the US provides a broad array of public health services, including some programs and activities related to obesity prevention, though the extent to which obesity prevention programs are being implemented in localities where obesity prevalence is the highest is unknown. This study examines the extent to which local health agencies appear to be addressing obesity prevention in their jurisdictions by examining the association between the existence of obesity prevention programs, jurisdiction level obesity prevalence and other organizational characteristics.

Methods

Data

Local health department data were obtained from the National Association of City and County Health Officials (NACCHO) Profile Study of Local Health Departments, which conducted a nationwide survey of LHDs in 2005 (response rate 82%, n=2,300) to collect information on a broad range of organizational characteristics and activities.[29] The survey was designed to be completed by multiple respondents as necessary to answer questions across the range of activities and program areas within each LHD. The existence of obesity prevention activities in an LHD was defined based on each agency's respondent(s) indicating whether or not obesity prevention was among the population-based primary prevention activities delivered by the LHD, which was one among a large number of activities across program areas for which respondents indicated whether or not the LHD delivered the program directly, contracted the services, or whether they knew of other organizations delivering services in the jurisdiction. Given that the purpose of this analysis was to address obesity prevention activities performed directly by the LHD (contracting obesity prevention services was reported in only 2.7% of LHDs, and thus excluded), information on whether other agencies (state, other local, etc.) delivered obesity prevention services in the LHD jurisdiction was not examined. Since the analysis was conducted at the organizational and county level, this research was not considered to meet federal definitions for human subjects research and was deemed to be outside the purview of the institutional review board (IRB).

Characteristics of LHDs and their respective jurisdictions assessed as predictors of LHD activities in obesity prevention were county obesity prevalence (main predictor) and other LHD governance and organizational characteristics (covariates). County obesity prevalence (based on BMI ≥ 30) estimates for 2005 were based on published data; more detailed description is provided elsewhere.[8, 35] For multicounty jurisdictions, LHD obesity prevalence was computed as the weighted average (based on county population size) of

county obesity prevalence. Characteristics of governance structure included state vs. local governance and the existence of a local board of health. Other organizational characteristics fell into four main categories: infrastructure (size of population served and total LHD expenditures per capita), specialized staff (epidemiologist, health educator, nutritionist), related programming (WIC, chronic disease surveillance, behavioral risk factor surveillance, and tobacco prevention), and participation in community assessment and planning.

Geocoding LHD jurisdictions

While LHDs may be established by counties, cities, towns, townships, and special districts, LHD jurisdictions were defined with respect to county boundaries. Overall, 72% of the LHDs had jurisdictional boundaries that corresponded to a single county, 7% had jurisdictions that spanned multiple counties but still followed county boundaries, and 21% had a wide range of jurisdictional boundary scenarios. Each of these LHDs was assigned to one or more counties to allow for comparison with the county-level obesity prevalence data.

Analytical methods

The presence of obesity prevention activities was examined in relation to other LHD organizational characteristics based on frequency distributions and odds ratios (95% confidence intervals). Multilevel models were used to examine the impact of both LHD-level covariates as well as state-level clustering (and state vs. local governance as a state-level variable) on the likelihood of LHDs having obesity prevention programming.[36] First, a null model with only a random intercept was estimated to examine the influence of state on LHD programming. We then included obesity prevalence (split into quartiles) of the LHD jurisdiction (level 1) and subsequently, other LHD characteristics to investigate the extent to which they would alter the effect of obesity prevalence on the existence of obesity prevention programming based on a change-in-estimate algorithm.[37] Finally, we added a state-level (level 2) variable to see if the state-level variations were further explained by the difference in state level governance structure. The statistical significance for the fixed effect parameters was tested using the approximate t-test. For statistical inferences on covariance parameters, we used the likelihood ratio test. We used several measures to quantify the state level variations (or clustering) – the estimate of the random-part intercept, intraclass correlation coefficient obtained from latent variable method (ICC_LVM), and the median odds ratio (MOR); detailed descriptions of the latter two measures are described in more detail elsewhere.[38]

Using the geographical information system (GIS) software ArcView 9.3.1,[39] obesity prevalence and LHD obesity prevention programming were mapped by county. Where more than one LHD was assigned to a single county, if every LHD in that county had the same response regarding whether they had obesity prevention programming or not, the county was marked accordingly on the map. For 99 counties to which more than one LHD was assigned, the responses varied within the county. To decide on how to display these counties, the LHDs in these counties were grouped by their response. Next, size of LHD population served was tallied for the two groups and the county value was assigned to the greater sum. For example, if the sum of the population served by all the LHDs that offered obesity prevention programming was greater than that of the LHDs that did not offer programming, the county is marked on the map as having obesity prevention programming. For counties where no LHD participated in the NACCHO survey, the obesity prevention programming category was considered missing.

Results

Local health departments serving larger populations, with higher expenditures per capita, state governance of local agencies, those having an epidemiologist, health educator, and nutritionist on staff, having a WIC program, chronic disease surveillance, behavioral risk factor surveillance, tobacco prevention, and those having completed a community health assessment and health improvement plan in the past three years were more likely to have obesity prevention activities (Table 1). The strongest associations were found for having related programming and larger infrastructures (e.g., behavioral risk factor surveillance). Having larger infrastructures was also associated with obesity prevention programming, for LHDs serving large populations (500,000+) compared to populations <25,000, and for LHDs with expenditures per capita in the highest vs. lowest quartile. Having a local board of health did not increase the likelihood of having obesity prevention programming.

Results from the multilevel analysis indicated that LHDs in jurisdictions with the highest levels of obesity were no more likely to deliver obesity prevention programs than those with the lowest levels of obesity (Table 2). For LHD jurisdictions in the highest vs. lowest quartile of obesity prevalence, the OR for having obesity prevention was 1.09 (95% CI 0.73–1.63). Though adjustment for size of population served substantially altered the association between area obesity prevalence and service delivery,(OR= 1.48, 95% CI 0.98–2.23), stratified analyses indicated this was likely due to the ceiling effect of the high prevalence of obesity prevention programming in larger LHDs, which were also more likely to reside in lower obesity prevalence areas (results not shown in table).

Measures of variation of LHD obesity prevention programming (Table 3) indicated that states were an important source of clustering of LHD activities, with an area level variance (SE) of 1.09 (0.28). The ICC of 0.248 suggested that 24.8% of the variability in the likelihood of an LHD having obesity prevention programming is a function of the characteristics of that state. The median odds ratio of 2.07 indicated that the likelihood of having LHDs with obesity prevention programming was double in high likelihood states compared to states with low likelihood of programming. Including obesity prevalence of the LHD jurisdiction in the model did not substantially explain the state-level variation, nor did the addition of state governance as a state-level variable.

Discussion

This paper identified a gap that exists between the county-level distribution of obesity in the US and LHD delivery of obesity prevention programming, indicating that the local public health infrastructure may be lacking where obesity prevention is most needed. The map provided in Figure 2 provides a graphic depiction of these findings, showing the frequent mismatch between local areas within states that had high obesity prevalence but no LHD programming. However, it is likely that a large proportion of LHDs have not had reliable measures of the prevalence of obesity within their jurisdictions. Moreover, while LHDs with behavioral risk factor surveillance were more likely to have obesity prevention programming, suggesting that surveillance may bolster activities in prevention, there was no association with local area obesity prevalence (results not shown), reiterating the need for local data to drive local action. [40, 41]

This paper also extends previous work that examined LHD activities in obesity prevention[42] by investigating county obesity rates in relation to LHD activities and by modeling the multilevel structure of the data by examining state-level effects. The current results suggest that states explain a substantial portion of variation in LHD practice. For the 22% of LHDs in the survey sample governed by the state public health agency, states will play a direct role

in implementation strategies in local agencies they govern. However, in these data having a state governance structure did not alter the likelihood of LHD programming as a function of local obesity prevalence. Furthermore, the substantial proportion of variance unexplained by the state-level clustering indicates the need to examine multiple levels of influence in examining determinants of local practice. Frameworks for improving public health systems in general[43] and for obesity prevention in particular underscore the importance of a strong public health infrastructure at the local level.[44, 45] A study that evaluated an intervention to improve evidence-based practice in state and local public health settings found that respondents in local public health agencies were less aware of evidence-based guidelines in chronic disease prevention than state agencies, suggesting that strategies to improve knowledge of evidence-based practice may not be one-size-fits-all for state and local agencies. [46]

Though there are promising examples of local agencies that are leading obesity prevention efforts in their communities,[47, 48] it is uncertain whether the vast majority of LHDs have the resources needed to implement and sustain programs and policies once implemented. [15, 49] In 2005, only about 2% of all US health spending went to state and local public health agencies,[50] while a survey conducted in 2003 of the largest metropolitan health departments found that less than 2% of their budgets was spent on chronic disease.[49] The lack of funding for chronic disease is also reflected in findings that indicate financial inputs into LHDs are more strongly related to improvements in infectious disease than chronic disease.[51]

Given that funding may be scarce, it is still worthwhile to consider other drivers that determine LHD practice by influencing the allocation of resources and activities with respect to obesity prevention. Leadership is likely to play an important role. For example, having a leader who prioritizes obesity prevention may be a driving factor in LHDs particularly where funding is not specifically allocated.[52] One of the “diseases of disarray” described by Wiesner [53] is “hardening of the categories”—that is, the large number of categorical grants and contracts undertaken by state and local public health agencies. Categorical programs will always exist, and in many cases, are necessary because a policy maker may have an interest in a specific disease or population. But to the extent possible, agencies need to break out of the “silos” to develop more flexibility in funding streams and program implementation. This is crucial for obesity prevention since it includes multiple risk factors, disease outcomes, and priority populations that vary across settings. It is also important to recognize that other societal sectors are likely to play a role in implementing obesity prevention programs and policies, with the mix of sectors likely varying across local contexts. Strengthening linkages with other organizations, schools, community groups, business leaders, and other governmental agencies may point to way to improve both service delivery in LHDs and the ability of LHDs to bolster other groups engaged in community prevention.[54]

Socio-ecological frameworks suggest that contextual factors substantially contribute to the current obesity epidemic, and that the most effective solutions will involve modifying environments and enacting policies to promote physical activity and nutrition at the population-level.[45, 55–57] Various strategies based on these frameworks now exist to guide evidence-based practice (e.g., the Community Guide for Community Preventive Services, Cancer Control PLANET, the CDC Implementation and Measurement Guide, the IOM Report on Local Government Actions to Prevent Childhood Obesity, and the RWJF Action Strategies Toolkit for Advancing Policies to Support Healthy Eating and Active Living[10, 11, 58–60]). While dissemination of such guidelines is a positive step, active strategies are needed to guide the implementation of these recommendations such that they become a sustainable part of LHD practice. In agencies with a traditional focus on

individual-based prevention activities, activities that focus on environmental and policy change may be unfamiliar and require additional training and support.[48]

Now is a critically important time for implementation research in the LHD setting, with federal stimulus money being directed specifically to primary prevention activities, such as the recent funding initiative from CDC to local communities to conduct obesity prevention programs through population-based approaches, including policy, systems, and environmental changes (CDC-RFA-DP09-912ARRA09). The traditional system for moving evidence into practice, a 'producer-push' system where research findings are marketed in a unidirectional fashion from researchers to practitioners, is ineffective at influencing the decision making process and appears to have very little impact on the implementation of new intervention approaches.[61–64] A major challenge of moving research evidence into practice is to strengthen the feedback loop between the researchers generating evaluation evidence and the practitioners responsible for implementing interventions.[65, 66] Research among youth has also demonstrated that providing stakeholders with context-specific research findings and recommendations for action may be more effective at incorporating research findings into practice.[67] The dissemination and implementation research literature suggests that active and multi-modal strategies are more effective than passive strategies,[68] further emphasizing the importance of encouraging linkages between researchers and local practitioners to ensure that contextually appropriate interventions are integrated where they are most likely to have impact. Any research to practice model must take into account the day to day challenges and context faced by LHD administrators. These include lack of adequate training in the workforce, categorical funding of programs, competing demands for limited resources, and the need to balance short term demands and crises with long term public health challenges like obesity.[19, 53]

This study was subject to several limitations. While we could not assess direction of effect from these cross-sectional data, we hypothesized that LHDs should respond to local need (high obesity) based on the perspective that governmental agencies should be implementing practice at the local level with respect to where obesity prevention services are most needed. This study did not address the full spectrum of prevention delivery organizations, which would encompass a larger array of public and private entities, or attempt to delineate causes of local area obesity prevalence. [69] Given that activities related to obesity prevention may take place in other program areas (e.g., diabetes, cardiovascular disease), there is a potential for misclassification of these data if the cross-cutting nature of obesity prevention activities across categorical program areas was not recognized by respondents. With respect to defining geospatial boundaries of LHD jurisdictions, we relied on county boundaries which correspond to local administrative units for the majority of LHDs. There is currently no definitive method for aligning the geospatial boundaries of all LHD jurisdictions in the US with administrative boundaries corresponding to available surveillance data.[18] Furthermore, the county estimates of obesity prevalence were based on statistical models from state-based surveillance and not direct measurement for each US county; however, since such data do not exist, this represents the next best approach in lieu of local surveillance.[70]

In order for obesity prevention programs and policies to have improved population health impact, there is a need to better utilize the existing local public health infrastructure. The great strides made in tobacco control, often driven by local action, offer a model for obesity prevention.[27, 71, 72] If the goal is for LHDs to serve as a conduit for dissemination and implementation of obesity prevention at the local level, the question is what structures and processes would need to be improved in local agencies and networks for this to happen. In order to inform practice at the local level, practitioners and other stakeholders require timely and locally relevant data. Research is also needed to develop improved measures of LHD performance, activities, and capacity for obesity prevention in particular and chronic disease

prevention in general, for example, identifying valid measures of local public health practice beyond self-report. Improving methods for dealing with organizational heterogeneity will also be needed to make appropriate inferences, learn from what works in various settings and target strategies accordingly. Implementation strategies that may modify the capacity of the existing workforce in the context of the necessary financial investment should be investigated. For example, enhancing skills in economic evaluation[73] and communicating with policy makers[74] could improve LHD capacity to strengthen linkages with local policy makers, community stakeholders, and other organizations and institutions that will play a role in local government strategies to prevent obesity.[59]

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Abbreviations

LHD	local health department
NACCHO	National Association of County and City Health Officials
BRFSS	Behavioral Risk Factor Surveillance System

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Biographies

Katherine Stamatakis received an M.P.H. from Saint Louis University and a Ph.D. in epidemiology from the University of Michigan. Her work has focused on the social epidemiology of lifestyle factors related to the primary prevention of cancer and chronic disease. She is specifically interested in studying the public health infrastructure as it relates

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Scott Leatherdale received his Ph.D. from the University of Waterloo (Canada). He has received research grants to support his work in the areas of infrastructure development, population-level data collection systems, ecological influences on behaviour, lifestyle factors associated with cancer risk, program evaluation, and the impact of policy on cancer risk behaviours.

Christine Marx holds a Master of Arts degree in Urban Affairs from Saint Louis University. As a research data manager, she has extensive experience collecting, cleaning and managing geo-referenced environment and patient data, as well as secondary data from various sources, including Census Bureau applications, the Bureau of Labor Statistics, and state and local Economic Development agencies.

Yan Yan obtained his M.D. from Peking Union Medical University (China) and Masters degree of biostistics and PH.D. of epidemiology from Johns Hopkins University. As a clinical epidemiologist/biostatistician, he regularly serves as a collaborator for other investigators. His research interest is in developing and validating risk models and causal inference.

Graham Colditz received his M.D. from the University of Queensland, and his M.P.H. and Dr.P.H. from Harvard University School of Public Health. With longstanding interest in the causes and prevention of chronic disease, particularly among women, Dr. Colditz has evaluated lifestyle factors including postmenopausal hormone therapy and breast cancer risk, and has developed statistical models to predict cancer risk. Other areas of expertise include tobacco and obesity in relation to cancer and other chronic diseases.

Ross Brownson holds a Ph.D. in epidemiology from Colorado State University. His extensive experience includes designing, implementing, and evaluating interventions to control cancer; implementation of large population-based surveys; dissemination research; policy research; development of measures; and translation of science into public health practice. He has led numerous large projects addressing physical inactivity, unhealthy eating, and other cancer risk factors. Many of these projects have involved research partnerships with public health practitioners.

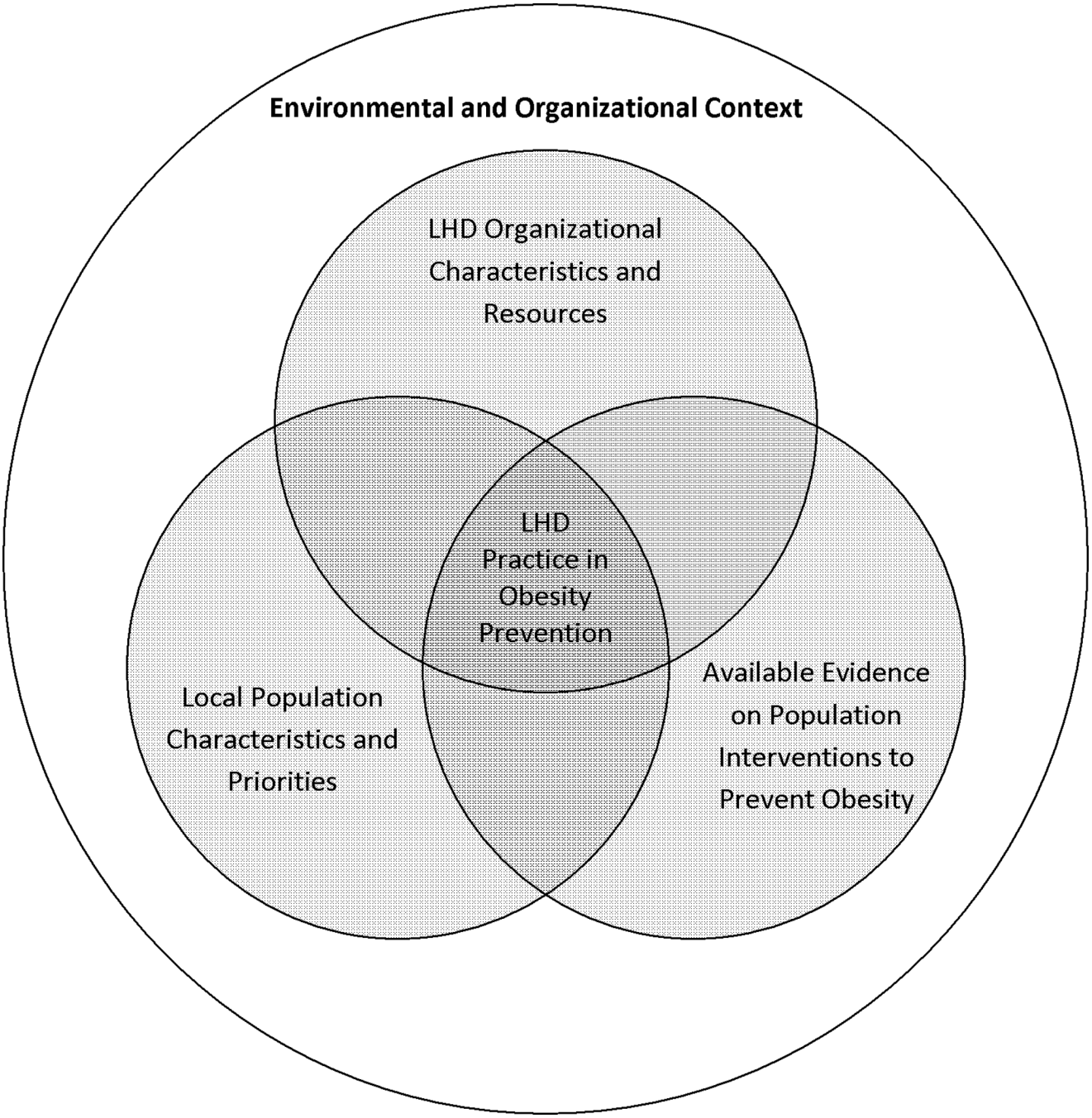

Figure 1.
Factors that may influence the ability of local health departments to implement evidence-based practice in obesity prevention*
*Adapted from Satterfield et al., 2009[26]

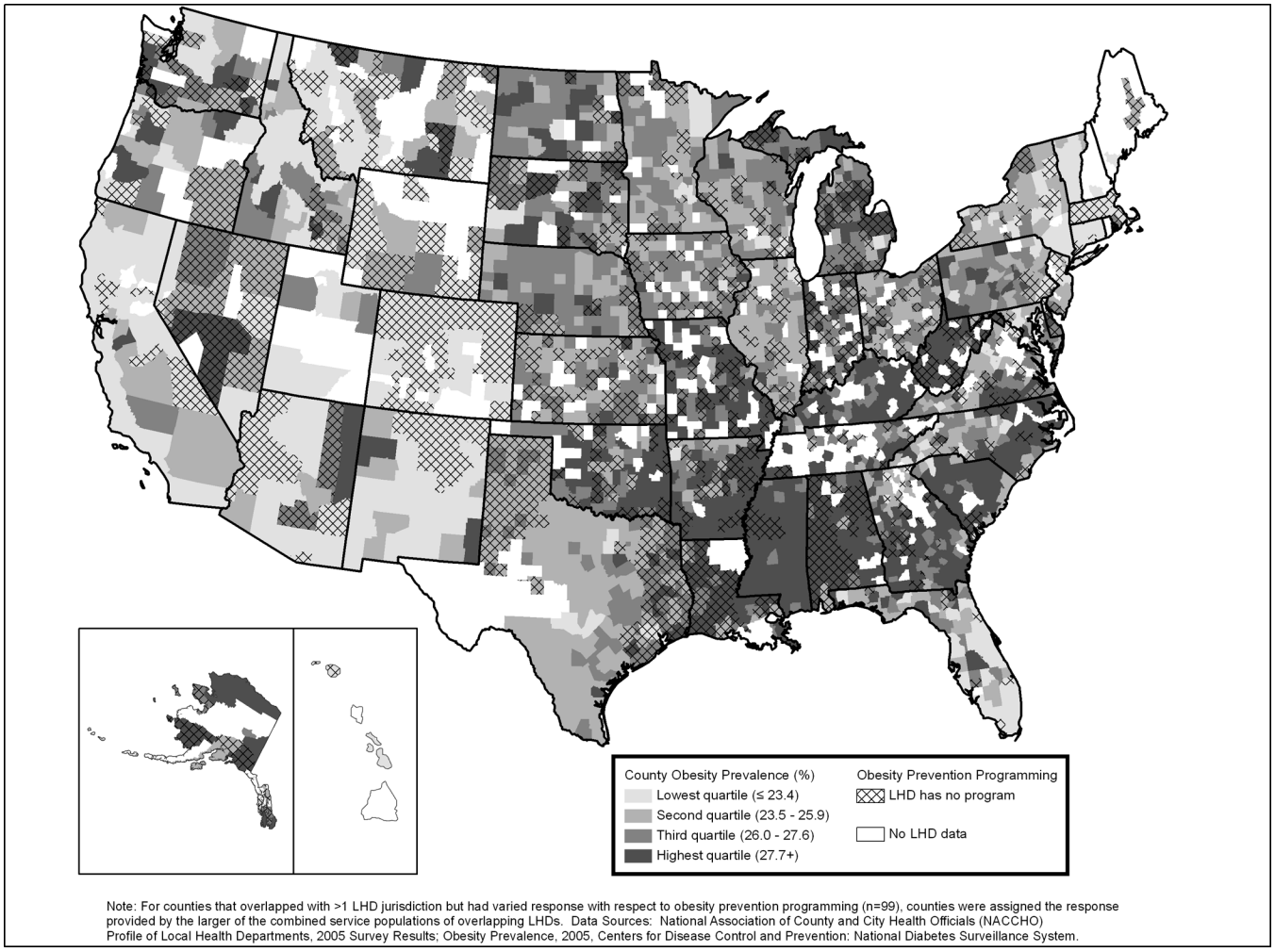

Figure 2.
Map of local health department obesity prevention programming and county obesity prevalence, United States 2005

Table 1

Frequency distribution and odds ratio for the presence of LHD obesity prevention activities across LHD organizational characteristics, 2005 Profile Study of Local Health Departments (n=2,300)

	LHD conducts obesity prevention activities		Unadjusted Odds Ratios (OR)	
	Freq.	**%**	**OR**	**95% CI**
Infrastructure				
Size of population served				
<25,000	420	45.4	1.00	
25,000–49,999	271	55.4	1.49	(1.20,1.86)
50,000–99,999	208	61.0	1.88	(1.46,2.42)
100,000–499,999	261	65.2	2.25	(1.77,2.87)
500,000+	99	78.0	4.24	(2.74,6.58)
Expenditures per capita				
Quartile 1 (<$16.78)	169	33.7	1.00	
Quartile 2 ($16.78 – 29.48)	280	55.7	2.47	(1.92,3.19)
Quartile 3 ($29.48 – 50.19)	330	66.4	3.89	(2.99,5.06)
Quartile 4 ($50.19 +)	356	70.9	4.80	(3.68,6.28)
LHD Governance				
State is governing body				
Yes	287	60.2	1.29	(1.05,1.59)
No	974	53.9	1.00	
Local Board of Health				
Yes	944	55.6	1.05	(0.87,1.27)
No	317	54.4	1.00	
Specialized Staff				
Epidemiologist on staff				
Yes	295	72.0	2.20	(1.73,2.79)
No	804	53.8	1.00	
Health educator on staff				
Yes	704	72.6	3.17	(2.63,3.82)
No	465	45.6	1.00	
Nutritionist on staff				
Yes	656	70.1	2.63	(2.17,3.16)
No	492	47.2	1.00	
Related Programming				
Has WIC program				
Yes	968	66.3	3.58	(2.99,4.29)
No	291	35.4	1.00	
Chronic disease epi./surv				
Yes	685	74.8	4.11	(3.42,4.95)

	LHD conducts obesity prevention activities		Unadjusted Odds Ratios (OR)	
	Freq.	**%**	**OR**	**95% CI**
No	568	41.9	1.00	
Behav. risk factor epi./surv				
Yes	632	80.1	5.55	(4.53,6.79)
No	625	42.1	1.00	
Tobacco prevention				
Yes	1112	73.4	11.50	(9.29,14.22)
No	147	19.3	1.00	
Participation in Community Assessment and Planning				
Completed health assessment <3 yrs				
Yes	802	68.7	3.09	(2.60,3.67)
No	456	41.5	1.00	
Developed health improvement plan <3 yrs				
Yes	825	68.1	3.03	(2.55,3.60)
No	435	41.3	1.00	

Table 2

Relationship between obesity prevalence in the LHD jurisdiction and the likelihood of having obesity prevention activities: Odds ratios (OR) and 95% confidence intervals (CI) from multi-level models with state-level clustering of LHD jurisdictions

			Crude		Adjusted for size of population served	
			OR	**95% CI**	**OR**	**95% CI**
Obesity prevalence quartiles	Freq.	%				
Quartile 1 (≤ 23.4 %)	260	44.6	1.00		1.00	
Quartile 2 (23.5–25.9 %)	346	61.0	1.22	(0.85, 1.74)	1.49	(1.04, 2.16)
Quartile 3 (26.0–27.6 %)	326	57.6	1.13	(0.78, 1.64)	1.45	(0.98, 2.13)
Quartile 4 (27.7+ %)	328	57.8	1.09	(0.73, 1.63)	1.48	(0.98, 2.23)

Table 3

Measure of variation or clustering of LHD obesity prevention programming across states

	Model 1: Accounting for state-level clustering only	Model 2: Model 1 + Obesity prevalence in LHD jurisdiction	Model 3: Model 2 + state-level governance structure
Area level variance	1.0874(0.2789)[1]	1.0741(0.2765)	1.0892(0.2812)
Proportional Change in Variance		−1.223	1.405
Median Odds Ratio	2.704	2.687	2.706
Intraclass Correlation Coefficient[2]	0.2484	0.2461	0.2487

1) $P < 0.001$, likelihood ratio test for covariance parameter (variation among the states) =0

2) ICC calculation based on the latent variable method for binary outcomes