

Factors Associated with LPHA Participation in Core Public Health Functions Related to Obesity Prevention, 2008

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Obesity is the leading public health problem in the U.S. Local public health agencies (LPHAs) are tasked with prevention on the community level. Conceptual frameworks link infrastructure to delivery of care. Infrastructure is measured by structural factors associated with LPHAs and environmental factors linked to obesity prevention; process is measured by participation in core public health factors associated with obesity prevention. Community-based interventions for obesity prevention have not been successful. If process is ineffective, structural and/or environmental factors need to be examined. This study examines what structural factors influence LPHA participation in obesity prevention.

INTRODUCTION

The Institute of Medicine issued a report in 1988 stating that public health as an organization is in a state of chaos and made many recommendations for improvement (Institute of Medicine, 2003). On the community level, local public health agencies (LPHAs) play a critical role in maintaining and improving health. LPHAs have been called “where the rubber meets the road” in terms of providing services to the public (Turnock, 2007) and, according to an Institute of Medicine report, “the backbone of the public health system (Novick, Morrow, & Mays, 2008). Another definition states that LPHAs “...are responsible for creating and maintaining conditions that keep people healthy” (Novick, Morrow, & Mays, 2008).

Obesity is one of the nation’s biggest threats to the health of the U.S. population (Jia & Lubetkin, 2010) and is a leading public health problem in the U.S. (Ogden et al., 2006; Anderson et al., 2005). Obesity affects all ages, ethnic groups, regions of the county and levels of socioeconomic status (Jeffery

& Utter, 2003). Compared to whites, non-Hispanic blacks, Mexican Americans, Native Americans and Puerto Ricans have higher levels of obesity, and Asian Americans exhibit lower levels of obesity (Denney et al., 2004). Rural populations, compared to urban populations, have higher obesity prevalence (Patterson et al., 2004; Jackson et al., 2005). Rates of childhood obesity have doubled or tripled, depending on the age group considered, from the late 1970s to the late 2000s (Ogden et al., 2006; Centers for Disease Control and Prevention [CDC], 2011). In addition, the government pays for approximately 50 percent of the total annual medical expenditures linked to obesity through Medicaid and Medicare beneficiaries (Finklestein, Ruhn, & Kosa, 2005). Based on the magnitude of what the government pays for care for the obese population, it has a vested interest in solving the obesity epidemic.

The relationship between LPHAs and obesity prevention is not well chronicled. Since the 1970s, a number of community-based obesity prevention programs have been developed and implemented, such as the Minnesota Heart Health Program (MHHP), the Pound of Prevention program, and the Stanford Three-Community program. Each of these programs differed in duration and types of informational and/or educational components included. None of the programs had long-term benefit and only MHHP and the Stanford-Three Community program had short-term reduction of specific risk factors with certain populations studied (Jeffery et al., 1995; Schmitz & Jeffery, 2000). These large-scale studies, although significant, did not specify the driver of planning, design or implementation of the programs.

With success of community-based obesity prevention efforts not being realized, evaluation efforts are critical to understanding why. The success of prevention programs relies on the “capacity of a community to engage in prevention efforts (Ataguba & Mooney, 2011). With the government’s economic interest in the obesity rates and the health of the population, prevention and control becomes critically important. Current research about obesity prevention programs and interventions focuses on health education and behavior change, but does not include the examination of system in which the problem can be solved (Abrams & Brownell, 2009).

The role of the public health system in combating obesity has recently been published (Zhang et al., 2010; Erwin et al., 2011; Luo et al., 2013; Stanatakis et al., 2012; Pomeranz, 2011; Chen et al., 2012). As obesity is a very serious health problem in the U.S. (Jia & Lubetkin, 2010; Ogden et al., 2006; Anderson et al., 2005), this proposed study will reveal what infrastructural factors influence participation in the 10 essential public health services for obesity prevention and might identify areas where organizational infrastructure and environmental factors support or hinder the delivery of obesity prevention services.

METHODS

An analysis of data from the 2008 National Association of City and County Health Officials (NACCHO) Profile surveys was used to assess the degree to which LPHAs are engaging in each of the 10 essential public health activities with regard to obesity prevention and the extent to which infrastructure is associated with this engagement. The 2008 data set consists of responses about infrastructure, activities and obesity prevention for a large proportion of the 3200 local public health agencies in the U.S. The NACCHO data sets were created from electronic surveys of local public health agencies with consistent follow-up with paper surveys to increase response rate. The 2008 data set was selected based on the questions asked pertaining to specific infrastructure and activities performed, and this data was collected before the significant economic downturn that started in the late 2000s.

Conceptual Framework

Handler, Issel and Turnock created a conceptual framework for measuring the performance of the public health system in 2001 (Handler, Issel, & Turnock, 2001) and was later modified by Mays et al in 2009 (Mays et al., 2009). The framework is based on the Donabedian model, which states that effective structure yields effective process, which, in turn, yields positive outcomes (Donabedian, 1988). Although the Donabedian model was designed to assess quality of provider care, the model can apply to other health service providers, including public health agencies. In the Donabedian model, “structure” pertains to the “attributes of the setting in which care occurs (Donabedian, 1988). Rather than structure referring to

such things as facilities, equipment, and finances of a hospital or medical office, structure in a public health setting would include governing body, funding, and workforce (executive and staff) characteristics. Process in the Donabedian model refers to “what is actually done in giving and receiving care” (Donabedian, 1988). In a public health context, process would apply to the specific public health services and how those services are delivered to the public or the community. Such services include obesity and other prevention services, which could be delivered, for example, through partnerships or directly. Outcomes signify the “effects of care on the health status of patients and populations” (Donabedian, 1988). In terms of public health, the definition of outcomes is no different. For the purposes of this study, outcomes are not examined. When applying the Donabedian framework to obesity prevention services as “process,” understanding the influence of “structure” on process becomes important as it can show the influence of structural elements have on service delivery.

Independent Variables

Structural elements of LPHAs include jurisdiction boundaries (county, other), jurisdiction size/ population size served, staffing levels, presence of community-based partnerships, funding levels, statutory authority (state, local), governance (governed by local board of health or not), leadership (operationally defined as top agency executive with terminal degree). In addition, the Handler et al and Mays et al. frameworks also show that environmental factors influence the structural factors. Environmental factors pertaining to obesity prevention used in this study include state BMI (body mass index) level and presence of CDC funding designated for obesity prevention. Environmental factors were obtained from the CDC (CDC, 2010).

Dependent Variables

The key variables in this proposed study are the 10 essential public health services performed in relation to obesity prevention in 2008. Data was coded to create dichotomous variables that show the presence of each of the 10 essential public health services for obesity prevention. A list of the 10 essential public health functions is included in Table 1.

In addition, a new variable was created that shows what core public health function --assessment, policy development and assurance – was performed based on the number of related essential public health activities the LPHA reported doing.

Statistical analysis performed included percentages, t test, ANOVA and linear regression as well as tests for model specification issues, such as multicollinearity and heteroscedasticity. No bias issues were revealed pertaining to multicollinearity and heteroscedasticity. All analysis was done using weighted data in SAS 9.3.

RESULTS

Frequency of LPHAs Performing Essential Public Health Activities Related to Obesity Prevention

Table 1 provides descriptive information about the percentage of LPHAs involved in each of the 10 essential public health functions as they relate to obesity programs as reported in 2008. More than two thirds of all responding LPHAs (68.83%) are involved in informing and educating people about obesity. More than half report working in mobilizing community partnerships (50.77%), linking people to needed services/outreach and referral (52.15%) and monitoring health status (50.04%). More than two fifths of LPHAs (41.89%) report diagnosing and investigating obesity-related problems in the community. Just under one-third (32.74%) of LPHAs report being engaged in policy making and planning and assuring staff (32.03%) are competent to provide services. Slightly less than one quarter of LPHAs (23.34%) are evaluating program effectiveness. Less than one fifth of LPHAs are involved in research pertaining to obesity programs (13.64%) and only a small percentage of LPHAs are enforcing laws related to obesity (3.75%). Nearly one-fifth (18.91%) of LPHAs report there is no activity in obesity prevention.

Variables were then collapsed to reflect LPHA involvement in the core essential public health functions of assessment, policy development and assurance related to obesity prevention. Assessment is

comprised of essential public health activity 1 (monitoring health problems) and 2 (diagnosing and investigating health problems). Policy development is based on essential public health functions 3 through 5 (informing, educating and empowering people; mobilizing community partnerships and developing policies and plans). Assurance includes essential public health functions 6 through 9 (enforcing laws and regulations, linking people to needed personal health services, assuring a competent workforce, evaluating effectiveness). Research, essential public health function 10, can occur in any of the essential public health functions. Without ability to link this essential public health function to a specific core activity in the data set, this variable was not included in the categorization and subsequent analysis.

Table 2 shows the percentage of LPHAs who participate in each core public health function as related to obesity prevention.

Bivariate Analysis Showing Factors Influencing Level of Participation in Assessment Activities Performed by LPHAs for Obesity Programs

Bivariate analysis was performed to provide more detail about the extent of the relationship between LPHA infrastructure and environmental factors and level of participation in core public health activities pertaining to obesity prevention. Tables 3-5 provide the results of bivariate analysis that shows level of involvement by each LPHA characteristic. Bivariate analysis was performed using t tests and ANOVA, depending on the number of levels of the independent variable of concern.

Assessment

Staffing levels, presence of partnerships with community-based organizations, staffing levels and state BMI levels were associated with level of participation in assessment-related activities pertaining to obesity prevention. There were positive associations between levels of involvement in assessment activities and staffing levels, presence of partnerships with community-based organizations, funding levels, and state BMI levels.

From using the mean square, there was a significant difference in participation in assessment activities between LPHAs with staffing levels of less than 6.5 FTE and LPHAs with staffing levels with more than 47 FTE. There was no significant difference between LPHAs that have staffing levels of 6.5 and 16.5 FTE and LPHAs with staffing levels greater than 47 FTE. Also, there was no significant difference between LPHAs that have staffing levels between 16.5 and 47 FTE and LPHAs with staffing levels greater than 47 FTE.

There was also a significant difference (data not shown) in participation in assessment activities between LPHAs with staffing levels of less than 6.5 FTE and LPHAs that have between 16.5 and 47 FTE. Also, there was a significant difference in involvement in assessment activities between LPHAs with less than 6.5 FTE and LPHAs that have between 6.5 and 16.5 FTE. Comparing LPHAs with staff levels between 6.5 and 16.5 FTE, there was no significant difference with LPHAs with either of the larger categories of FTE ranges.

There was a significant difference in participation in assessment activities based on state BMI rate. Participation in assessment-related activities related to obesity prevention increases as state BMI levels increase from normal weight to overweight and from normal weight to obese. There was no significant difference in participation in assessment activities between LPHAs with state BMI rate in the overweight category and the obese category.

Participation in assessment-related activities increases as funding levels increase from less than \$500,000 annually to amounts greater than \$2.5 million. Participation in assessment-related activities increases as funding levels increase from less than \$500,000 annually to amounts between \$500,000 and \$2.5 million. There was no significant difference in participation in assessment activities between LPHAs with funding levels between 500,000 and 2.5 million and LPHAs with funding levels greater than 2.5 million (data not shown).

Policy Development

Population size served, staffing levels, presence of partnerships with community-based organizations, staffing levels and state BMI level are associated with participation in policy development activities pertaining to obesity prevention. There were positive associations between levels of involvement in policy development activities and jurisdiction size, staffing levels, presence of partnerships with community-based organizations, funding levels, and state BMI levels.

From using the mean square, participation in policy development activities related to obesity prevention was statistically higher in LPHAs serving more than 250,000 people than in LPHAs serving less than 50,000 people and LPHAs serving between 50,000 and 250,000 people. Also (data not shown), there was a difference in involvement in policy development activities between LPHAs serving between 50,000 and 250,000 people and LPHAs serving more than 250,000 people.

Comparing to staffing levels of more than 47 FTE, there were significant differences in participation in policy development activities related to obesity prevention between every level of staffing.

There were also (data now shown) significant differences in involvement in policy development activities between LPHAs with less than 6.5 FTE and LPHAs with 6.5 to 16.5 FTE, between 6.5 and 16.5 FTE and 16.5 and 47.5 FTE. There were no significant differences between LPHAs with 16.5 to 47 FTE and FTE with more than 47 FTE.

Participation in policy development-related activities related to obesity prevention increase as state BMI levels move from normal weight to overweight, but there was no change in involvement in policy development activities as state BMI levels move from overweight to obese.

There were significant differences in involvement in policy-making activities related to obesity prevention based on funding levels. Compared to the annual funding levels less than \$500,000, LPHAs with funding levels between \$500,000 and \$2.5 million have greater participation in policy development, as does LPHAs with more than \$2.5 million in annual funding. Further analysis (data not shown) revealed that involvement in policy development-related activities increases as funding increases; there were significant differences between each individual level.

Assurance

The bivariate analysis pertaining to the core public health function of assurance reveals that staffing levels, presence of partnerships with community-based organizations, and funding levels were associated with participation in assurance-related activities pertaining to obesity prevention.

Compared to LPHAs with more than 47 FTE, there were significant differences in participation in assurance activities for LPHAs with fewer than 6.5 FTE and for LPHAs with between 16.5 and 47 FTE. There was no significant difference in participation in assurance activities between LPHAs with more than 47 FTE and LPHAs with 6.5 to 16.5 FTE.

Additionally (data not shown), there were significant differences in involvement in assurance activities between LPHAs with fewer than 6.5 FTE and LPHAs with 6.5 to 16.5 FTE. There were also significant differences in participation in assurance activities between LPHAs with fewer than 6.5 FTE and LPHAs with 16.5 to 47 FTE. There was no significant difference in involvement between LPHAs with 6.5 and 16.5 FTE and LPHAs with 16.5 to 47 FTE.

Compared to LPHAs with less than \$500,000 in annual funding, there was no significant difference in involvement in assurance activities for LPHAs with funding levels between \$500,000 and \$2.5 million. However, there was a significant difference in involvement in assurance activities between LPHAs with less than \$500,000 in annual funding and LPHAs with more than \$2.5 million in annual funding.

Regarding state BMI levels, compared to LPHAs in states with an average BMI of 30 or greater, there were no significant differences in involvement in assurance activities with LPHAs in states with a normal BMI rate (less than 25) and in states with an overweight BMI rate (between 25 and less than 30).

There were significant differences in participation in assurance activities between LPHAs with less than \$500,000 in annual funding and LPHAs with more than \$2.5 million in annual funding.

Infrastructure and Environmental Factors Associated with LPHA Involvement in Core Public Health Functions Pertaining to Obesity Prevention, 2008

Tables 6-8 shows the structural and environmental factors associated with LPHA participation in each core public health functions related to obesity prevention.

Assessment

Staffing levels was the only significant factor influencing LPHA participation in assessment activities related to obesity prevention, and there was a positive association between the two. Presence of partnerships with community-based organizations and state BMI level approached statistical significance.

Policy Development

Staffing levels and presence of a partnership with a community-based organization are positively associated with LPHA participation in policy development activities related to obesity prevention.

Assurance

No structural or environmental factors in the analysis were found to be significantly related to level of assurance activities.

DISCUSSION

The discussion is divided into three sections: 1) discussion of overall findings, 2) discussion of the proportion of LPHAs engaged in essential public health services related to obesity prevention, and 3) discussion of the factors associated with LPHA participation in core public health functions related to obesity prevention

Overall Findings

The results shown thus far speak to the effect that a single dimension of the Mays et al. and Handler et al. conceptual frameworks has on the strategic decision to participate in the core public health functions related to obesity prevention. Governmental public health agency characteristics play a small role in involvement in core public health functions. The addition of obesity-related environmental factors – state BMI level and presence of CDC funding allocated to states for obesity prevention – also play a small role in participation in the core public health functions. Presence of CDC funding does not play such a role.

Proportion of LPHAs Engaged in Essential Public Health Services Related to Obesity Prevention

Also, as seen in Table 1, only four essential public health activities (monitoring health status, informing and educating about health issues, mobilizing community partnerships, and linking people to needed personal health services) are performed by more than half of LPHAs, and no essential public health function is performed by more than 75 percent of LPHAs. With the results of this study showing that characteristics of LPHAs have little influence on participation in core public health functions related to obesity prevention, then there must be other factors that are influencing at involvement in obesity prevention at the community level. Based on the Mays et al. and Handler et al. conceptual models, it would be logical to hypothesize that the community partners are providing greater support to prevent obesity than are LPHAs.

Factors Associated with Core Public Health Functions Related to Obesity Prevention

From examining the results of the regression model with the results of the bivariate analysis, staffing level is the only significant variable associated with participation in assessment and policy development activities. The significance of staffing levels speaks to the importance of the role of people in battling obesity. LPHA staff size is meager compared to other organizations with a similar range of activities (Novick, Morrow, & Mays, 2008). Having the staff to deliver assessment and policy development activities, holding all other variables constant, plays a key role. As stated earlier, people/staff perform the

actual delivery of the intervention. People/staff also educate the public about health issues, create and maintain partnerships, and develop policies and plans to support health efforts. The positive association between staffing levels and the core functions of assessment and policy development shows that the more people, the more participation in those activities. As funding was not significant, this finding suggests that staff used in obesity prevention activities may be funded to perform different work, but are doing obesity prevention in addition to their main job. Staff doing such work may be working with community-based partnerships to implement obesity prevention.

No structural or environmental factors studied are associated with LPHA participation in assurance. This finding suggests, based on the conceptual model of the public health system, that the role of governmental public health agency does not play a significant role in the strategic decisions made and that the factors associated with participation in assurance activities comes from macro factors outside of LPHA characteristics and/or from the population and environment. This study examined two population and environmental factors – state BMI level and presence of CDC funding designated to states for use for obesity prevention – and neither factor was found significant. State BMI level only showed influence in the bivariate model.

Presence of community-based partnerships was only significant in the model pertaining to policy development activities related to obesity prevention, holding all else constant. The Institute of Medicine states that the magnitude of the obesity problem in the U.S. is bigger than what government public health agencies can handle and recommends that public health engage in partnerships (Institute of Medicine, 2003). The results of this study show that presence of community-based partnerships is associated with assessment activities related to obesity prevention in the bivariate model and with policy development activities in the bivariate and full models. In short, taking other variables into account, presence of community-based partnership is an important factor linked to participation in policy development and that community-based partnerships increase, so does participation in policy development activities. There is no such increase with assessment and assurance activities related to obesity prevention.

Participation in obesity prevention at the local level is certainly important, but challenging in light of competing priorities and diminishing revenues. With LPHAs being all things prevention to all people, securing community-based resources specializing in obesity prevention-related activities may be part of the most pragmatic and sustainable way to solve the obesity problem in the U.S.

Limitations

This study has a number of limitations. The 2008 NACCHO profile survey has not been tested for validity and reliability. Questions in the survey have weak face validity as wording used is subject to interpretation. For example, questions in the survey that pertain to obesity are not specific to either adult obesity, childhood obesity or both. In this study, obesity is assumed to pertain to adult only.

Proxy variables were created for some of the variables in the conceptual framework; use of different proxies could yield different results. For example, the presence of a terminal degree held by the agency's top executive was used as a proxy for leadership. In addition, results may differ based on variables used. For example, there are other ways that partnerships with community-based organizations could have been analyzed; use of other variables also could yield different results. The percentage of federal funding above the national average received by LPHAs was used to represent funding mix in the conceptual framework; better proxy variables could be used and, thus, could have different results.

Conclusion

This study examined the relationship between various structural and environmental factors of LPHAs and participation in essential and core public health functions related to obesity prevention. The results showed that only a few factors within the conceptual frameworks developed by Mays et al. and Handler et al. have a significant influence on LPHA participation in obesity prevention.

The Institute of Medicine states that the most promising course for obesity prevention is population-based and multi-level, addresses environmental and policy change, and requires the assistance of multiple sources (Kumanyika et al & Institute of Medicine (U.S.), 2010). Thomas Freiden makes

recommendations similar to the Institute of Medicine's course of action (Frieden, 2010). As IOM and Frieden recommendations were published after 2008, future research needs to determine if LPHAs are adhering to these important recommendations.

Future research needs to examine these significant variables, particularly community-based partnerships, in more depth. Although this study shows an association between presence of community-based partnerships and policy development, the extent, nature, role, and effectiveness of the partnership in combating obesity prevention on the community level are not known.

In addition, future research should also involve understanding what activities are being performed within key essential public health functions and identify what factors influence the participation in key essential public health functions related to obesity prevention.

Of additional interest related to this study includes analysis pertaining to differences between rural and urban LPHAs as well as differences between LPHAs in the 16 Southern Obesity states and those LPHAs not in the 16 Southern Obesity states. As the obesity prevention problem continues to worsen, and while the community-based partnerships used in obesity prevention are not well understood, additional research is needed to understand the strength, roles and responsibilities, successes and obstacles faced by the LPHA/community-based organization partnership, especially in light of the strong IOM recommendation given to community-based partnerships. Understanding what may make partnerships successful could help create an obesity prevention model for LPHAs.

REFERENCES

Anderson, L. H., Martinson, B. C., Crain, L., Pronk, N. P., Whitebird, R. R., Fine, L. J., & O'Connor, P.J. (2005). Health Care Charges Associated with Physical Inactivity, Overweight and Obesity. *Preventing Chronic Disease*, 2(4), 1-12.

Ataguba, J. E., & Mooney, G. (2011). Building on 'the Concept of Prevention: a Good Idea Gone Astray?'" *Journal of Epidemiology and Community Health*, 65, 116–118.

Brownell, K. (Host). (2009, September 9). *The Rudd Report: Changing Systems to Improve Health*. Retrieved from <http://www.yaleruddcenter.org/podcasts.aspx>.

Centers for Disease Control and Prevention (CDC). (2011). Childhood Overweight and Obesity. *Overweight and Obesity*. Retrieved from <http://www.cdc.gov/obesity/childhood/index.html>.

CDC. (2010). U.S. Obesity Trends. *Overweight and Obesity 2010*. Retrieved from <http://www.cdc.gov/obesity/data/trends.html> and <http://www.cdc.gov/obesity/stateprograms/fundedstates.html>

Chen, Z., Roy, K., & Gotway Crawford, C. A., (2012). Obesity Prevention: The Impact of Local Health Departments. *Health Services Research*, 1-25.

Denney, J., Krueger, P. M., Rogers, R. G., & Boardman, J. D. (2004). Race/Ethnic and Sex Differentials in Body Mass Among US Adults. *Ethnicity and Disease*, 14, 389–398.

Donabedian, A. (1988). The Quality of Care. How Can It Be Assessed? *Journal of the American Medical Association*, 260(12) 1743–1748.

Erwin, P. C., Greene, S., Mays, G., Ricketts, T., & Davis, M. V. (2011). The Association of Changes in Local Health Department Resources with Changes in State-Level Health Outcomes. *American Journal of Public Health*, 101(4), 609–615.

- Finkelstein, E. A., Ruhm, C. J., & Kosa, K. M. (2005). Economic Causes and Consequences of Obesity. *Annual Review of Public Health*, 26, 239–257.
- Frieden, T. R. (2010). A Framework for Public Health Action: The Health Impact Pyramid. *American Journal of Public Health*, 100(4), 590–595.
- Handler, A., Issel, M., & Turnock, B. (2001). A Conceptual Framework to Measure Performance of the Public Health System. *American Journal of Public Health*, 91, 1235–1239.
- Institute of Medicine. (2003). *The Future of the Public's Health in the 21st Century*. Washington, D.C.: National Academies Press.
- Jackson, J. E., Doescher, M.P., Jerant, A. F., & Hart, L. G. (2005). A National Study of Obesity Prevalence and Trends by Type of Rural County. *Journal of Rural Health*, 21(2), 140–148.
- Jeffery, R. W., Gray, C. W., French, S. A., Hellerstedt, W. L., Murray, D., Luepker, R. V., & Blackburn, H. (1995). Evaluation of Weight Reduction in a Community Intervention for Cardiovascular Disease Risk: Changes in Body Mass Index in the Minnesota Heart Health Program. *International Journal of Obesity*, 19: 30–39.
- Jeffery, R.W., & Utter, J. (2003). The Changing Environment and Population. Obesity in the United States. *Obesity Research*, 11, 12S–22S.
- Jia, H., & Lubetkin, E. I. (2010). Trends in Quality-Adjusted Life-Years Lost Contributed by Smoking and Obesity. *American Journal of Preventive Medicine*, 38(2), 138–144.
doi:10.1016/j.amepre.2009.09.043
- Kumanyika, S. K., Parker, L., Sim. L. J., & Institute of Medicine (U.S.). (2010). *Bridging the Evidence Gap in Obesity Prevention : a Framework to Inform Decision Making*. Washington, D.C.: National Academies Press.
- Luo, H., Sotnikov, S., Shah, G., Galuska, D. A., & Zhang, X. (2013). Variation in Delivery of the 10 Essential Public Health Services by Local Health Departments for Obesity Control in 2005 and 2008. *Journal of Public Health Management and Practice*, 19(1), 53-61.
- Mays, G. P., Smith, S.A., Ingram, R.C., Racster, L. J., Lamberth, C. D., & Lovely, E.S. (2009). Public Health Delivery Systems. *American Journal of Preventive Medicine*, 36(3), 256–265.
doi:10.1016/j.amepre.2008.11.008
- Novick, L. F., Morrow, C. B., & Mays, G. P. (2008). *Public Health Administration: Principles for Population-Based Management*. 2nd ed. Sudbury, MA: Jones and Bartlett Publishers.
- Ogden, C. L., Carroll, M. D., Curtin, L. R., McDowell, M. A., Tabak, C. J., & Flegal, K. M. (2006). Prevalence of Overweight and Obesity in the United States, 1999-2004. *Journal of the American Medical Association*, 295(13), 1549–1555. doi:10.1001/jama.295.13.1549
- Patterson, P.D., Moore, C. G., Probst, J.C., & Shinogle, J.A. (2004). Obesity and Physical Activity in Rural America. *Journal of Rural Health*, 20(2), 151–159.
- Pomeranz, J. L. (2011). The Unique Authority of State and Local Health Departments to Address Obesity. *American Journal of Public Health*, 101(7), 1192-1197.

Schmitz, M. K., & Jeffery, R.W. (2000). Public Health Interventions for the Prevention and Treatment of Obesity. *Obesity*, 84(2), 491–512.

Stamatakis, K. A., Leatherdale, S. T., Marx, C. M., Yan, Y., Colditz, G. A., & Brownson, R. C. (2012). Where is Obesity Prevention on the Map?: Distribution and Predictors of the Local Health Department Prevention Activities in Relation to County-Level Obesity Prevalence in the United States. *Journal of Public Health Management and Practice*, 18(5), 402-411. doi: 10.1097/PHH.0b013e318221718c

Turnock, B. J. (2007). *Essentials of Public Health. Vol. 2*. Sudbury, MA: Jones and Bartlett Publishers.

Zhang, X., Luo, H., Gregg, E.W., Mukhtar, Q., Rivera, M., Barker, L., & Albright, A. (2010). Obesity Prevention and Diabetes Screening at Local Health Departments. *American Journal of Public Health*, 100(8), 1434-1441. doi: 10.2105/AJPH.2009

APPENDIX OF TABLES

Table 1 - Proportion of LPHAs performing 10 essential public health activities -- obesity programs (2008)	
n=386	
10 Essential Public Health Service	(%)*
1. Monitor health status to identify and solve community health problems.	50.04
2. Diagnose and investigate health problems and hazards in the community.	41.89
3. Inform, educate, and empower people about health issues.	68.83
4. Mobilize community partnerships and action to identify and solve health problems.	50.77
5. Develop policies and plans that support individual and community health efforts.	32.74
6. Enforce laws and regulations that protect health and ensure safety.	3.75
7. Link people to needed personal health services and assure the provision of health care when otherwise unavailable.	52.15
8. Assure competent public and personal health care workforce.	32.03
9. Evaluate effectiveness, accessibility, and quality of personal and population-based health services.	23.34
10. Research for new insights and innovative solutions to health problems.	13.64
NA	18.91

* Weighted estimate.

Core Public Health Service	(%)*
Assessment	57.89
Policy development	73.39
Assurance	60.72

* Weighted estimate.

Variable	Assessment Mean Score	p value*
Overall Adjusted Average	.46	
Jurisdiction boundaries		
County	.96	Ref
Other	.86	.2944
Jurisdiction size		
< 50,000	.84	.0591
50,000 -- 250,000	1.02	.5637
250,000+	1.09	Ref
Staffing levels (in terms of full-time equivalents [FTE])**		
<=6.5	.52	<.0001
6.5 -- 16.5	1.02	.4300
16.5 -- 47	1.13	.9619
47+	1.12	Ref
Community-based Organizations (CBOs)**		
Presence of partnerships with CBOs	.97	<.0001
No presence of partnerships with CBOs	.32	Ref
Funding levels**		
< 500,000	.62	<.0001
500,000 -- 2.5 million	1.05	.0001
2.5 million+	1.10	Ref
Funding mix (federal in relation to ntl ave.)		
Funding level > national average	1.12	.1510
Funding level < national average	.96	Ref
Statutory authority		
State control	.92	.9720
Local control	.92	Ref
Governing structure		
Presence of local board of health	.92	.8323
No local board of health	.89	Ref
Leadership		
Top LPHA executive earned terminal degree	.79	.0872
Top LPHA executive does not possess terminal degree	.95	Ref
State BMI level**		
<25	.58	.0123
25-29	1.03	.5569
30+	.96	Ref
CDC Funds		
State received funding designated for obesity prevention	.92	.9494
State did not receive funding designated for ob. prevention	.92	Ref

*Bolted p values levels indicate statistical significance between identified level and referent level.

** Indicate variables that are statistically significant.

Table 4 - Factors Influencing Participation in Policy Development Activities Performed by LPHAs for Obesity Programs, 2008

Variable	Policy Dev. Mean Score	p value*
Overall Adjusted Average	.41	
Jurisdiction boundaries		
County	1.27	Ref
Other	1.21	.5162
Jurisdiction size**		
< 50,000	1.10	<.0001
50,000 -- 250,000	1.41	<.0148
250,000+	1.66	ref
Staffing levels**		
<=6.5	.82	<.0001
6.5 -- 16.5	1.29	.0107
16.5 -- 47	1.38	.0475
47+	1.59	ref
Community-based Organizations (CBOs)**		
Presence of partnerships with CBOs	1.30	.0001
No presence of partnerships with CBOs	.62	Ref
Funding levels**		
< 500,000	1.01	Ref
500,000 -- 2.5 million	1.28	.0387
2.5 million+	1.52	<.0001
Funding mix (federal in relation to ntl ave.)		
Funding level > national average	1.45	.1743
Funding level < national average	1.30	Ref
Statutory authority		
State control	1.21	.1149
Local control	1.30	Ref
Governing structure		
Presence of local board of health	1.19	.0926
No local board of health	1.38	Ref
Leadership		
Top LPHA executive earned terminal degree	1.21	.7120
Top LPHA executive does not possess terminal degree	1.25	Ref
State BMI level**		
<25	1.00	.0600
25-29	1.31	.9969
30+	1.31	Ref
CDC Funds		
State received funding designated for obesity prevention	1.16	.1335
State did not receive funding design. for obesity prev.	1.30	Ref

*Bolded p values levels indicate statistical significance between identified level and referent level.

** Indicate variables that are statistically significant.

Table 5 - Factors Influencing Participation in Assurance Activities Performed by LPHAs for Obesity Programs, 2008		
Variable	Assurance Mean Score	P value*
Overall Adjusted Average	.24	
Jurisdiction boundaries		
County	.95	ref
Other	.92	.7501
Jurisdiction size		
< 50,000	.90	.0319
50,000 -- 250,000	.95	.0896
250,000+	1.17	Ref
Staffing levels**		
<=6.5	.64	<.0001
6.5 -- 16.5	1.13	.8948
16.5 – 47	.91	.0463
47+	1.17	Ref
Community-based Organizations (CBOs)**		
Presence of partnerships with CBOs	.97	.0035
No presence of partnerships with CBOs	.48	Ref
Funding levels**		
< 500,000	.76	Ref
500,000 -- 2.5 million	.98	.0910
2.5 million+	1.11	.0047
Funding mix (federal in relation to ntl ave.)		
Funding level > national average	.98	.7477
Funding level < national average	1.02	Ref
Statutory authority		
State control	.93	.6097
Local control	.99	Ref
Governing structure		
Presence of local board of health	.88	.1074
No local board of health	1.06	Ref
Leadership		
Top LPHA executive earned terminal degree	.86	.4056
Top LPHA executive does not possess terminal degree	.96	Ref
State BMI level		
<25	.80	.6954
25-29	1.01	.2735
30+	.86	Ref
CDC Funds		
State received funding designated for obesity prevention	.94	.9572
State did not receive funding design. for obesity prev.	.94	Ref

*Bolded p values levels indicate statistical significance between identified level and referent level.

** Indicate variables that are statistically significant.

Table 6 –Factors Influencing Participation in Assessment Activities Performed by LPHAs for Obesity Programs, 2008 (n=216)			
Variable*	Coefficient	St. Error	P value
Jurisdiction boundaries	-.0896	.1289	.4877
Jurisdiction size	-.1169	.1209	.3350
Staffing levels	.2642	.1289	.0417
Intergovernmental relationships (Community-based Organizations)	.4950	.2564	.0549
Funding levels	-.0630	.1832	.7314
Funding mix (federal > ntl ave.)	.0564	.1226	.6462
Statutory authority	.1884	.2328	.4191
Governing structure	.1937	.18459	.2961
Leadership	-.2045	.1510	.1771
State BMI rate	.2209	.1265	.0822
CDC funding	.0632	.1252	.6142
*Intercept	-.3008	.4147	.4691
N	216		
Prob >F	.0148		
R ²	.0979		

*Bolded p values levels of variables that are statistically significant

Table 7– Factors Influencing Participation in Policy Development Activities Performed by LPHAs for Obesity Programs, 2008 (n=216)			
Variable*	Coefficient	St. Error	P value
Jurisdiction boundaries	-.0510	.1217	.6759
Jurisdiction size	-.0453	.1090	.6784
Staffing levels	.2629	.1276	.0406
Intergovernmental relationships (Community-based Organizations)	.6849	.2849	.0171
Funding levels	-.1231	.1867	.5104
Funding mix (federal > ntl ave.)	.0494	.1167	.6722
Statutory authority	-.0486	.2222	.8271
Governing structure	.0490	.1710	.7747
Leadership	.0794	.1154	.4919
State BMI rate	.1027	.1286	.4255
CDC funding	-.0677	.1282	.5981
*Intercept	.2952	.4248	.4878
N	216		
Prob >F	.0121		
R ²	.1136		

*Bolded p values levels of variables that are statistically significant

Table 8 – Factors Influencing Participation in Assurance Performed by LPHAs for Obesity Programs, 2008 (n=216)			
Variable*	Coefficient	St. Error	P value
Jurisdiction boundaries	-.1413	.1376	.3054
Jurisdiction size	-.1615	.1201	.1802
Staffing levels	.0987	.1318	.4548
Intergovernmental relationships (Community-based Organizations)	.3636	.2476	.1547
Funding levels	.1129	.1921	.5573
Funding mix (federal > ntl ave.)	-.0869	.1288	.5010
Statutory authority	.0492	.2616	.8511
Governing structure	-.0210	.1793	.9071
Leadership	-.0245	.1728	.8874
State BMI rate	.0761	.1469	.6050
CDC funding	.0416	.1363	.7604
*Intercept	.4400	.4404	.3189
N	216		
Prob >F	.5171		
R ²	.0443		