

Published in final edited form as:

J Maps. 2013 January 1; 9(1): 36–42. doi:10.1080/17445647.2013.765366.

Defining Neighborhood Boundaries for Urban Health Research in Developing Countries: A Case Study of Accra, Ghana

Ryan Engstrom¹, Caetlin Ofiesh¹, David Rain¹, Henry Jewell¹, and John Weeks²

Ryan Engstrom: rengstro@gwu.edu; Caetlin Ofiesh: caetie@gmail.com; David Rain: drain@gwu.edu; Henry Jewell: henryjewell@gmail.com; John Weeks: john.weeks@sdsu.edu

¹Department of Geography, The George Washington University, 1922 F St. NW Washington DC 20052

²Department of Geography, San Diego State University, San Diego, CA 9182-4493

Abstract

The neighborhood has been used as a sampling unit for exploring variations in health outcomes. In a variety of studies census tracts or ZIP codes have been used as proxies for neighborhoods because the boundaries are pre-defined units for which other data are readily available. However these spatial units can be arbitrary and do not account for social-cultural behaviors and identities that are significant to residents. In this study for the city of Accra, Ghana, our goal was to create a neighborhood map that represented the boundaries generally agreed upon by the residents of the city using the smallest available census unit, the enumeration area (EA), as the base unit. This neighborhood map was then used as the basis for mapping spatial variations in health within the city. The first step in demarcating the boundaries was to identify features that limit a person's movement including the major roads, drainage features, and railroad tracks that people use to partially define their neighborhood boundaries. Once an initial set of boundaries were established, they were iteratively modified by walking the neighborhoods, talking to residents, public officials, and others. The resulting neighborhood map consolidated 1,723 EAs into 108 neighborhoods covering the entire Accra metropolitan area. Results indicated that the team achieved 71 percent accuracy in mapping neighborhoods when the neighborhood keyed to the survey EA was compared with the response given by the interviewees in the 2008–2009 Women's Health Survey of Accra when asked which neighborhood they lived in.

Introduction

There is substantial evidence that there are significant health disparities and inequalities within cities (Montgomery and Hewett 2005; Mitchell *et al.* 2002; Rytkonen *et al.* 2001). In order to determine and understand these disparities and inequalities the neighborhood has been used as the spatial unit for exploring variations in health outcomes in a number of different studies (e.g., Santos *et al.* 2010; Weiss *et al.* 2007; Diez Roux 2001). The social, institutional, and physical characteristics of the neighborhood have been linked to various health outcomes (Diez Roux 2003, Diez Roux *et al.* 2001, O'Campo *et al.* 1997) and behaviors (Morland *et al.* 2002, Yen *et al.* 1998). This research supports the idea that where a person lives (i.e., their neighborhood) influences their health, thus leading to spatial disparity in health outcomes within a city.

There is a general, if not unanimous, consensus within the literature that neighborhood refers to a geographic unit of limited size, with relative homogeneity in housing and population, as

well as some level of social interaction and symbolic significance to residents (Weiss *et al.* 2007, Chaskin 1997, Gephart 1997). While the idea of the unit can be defined, determining the boundaries of a neighborhood can be difficult, and the subjectivity of these boundaries is widely accepted (Weiss *et al.* 2007). Because of the challenges involved in delineating neighborhood boundaries, many studies simply use predetermined units such as census tracts and ZIP codes to create their “neighborhoods.” These have the advantage of being easily identifiable, replicable, and can be linked to the secondary data source (i.e., the census) (Weiss *et al.* 2007). However, they are limited because these spatial units do not account for the homogeneity and social interaction criteria used in defining a neighborhood, and local level variability may be obscured if these units are too large (Pickett and Pearl 2001). In some cases such as those for measuring health outcomes, the most appropriate boundaries may depend on the outcome being investigated, but in others it may be advantageous to develop a map based on resident’s perceptions and natural boundaries to test the relationship between community perceptions of neighborhood and health outcomes.

Accra, the capital city of Ghana, is a rapidly developing coastal West African city. Accra was originally established as a fishing village that grew significantly once the British relocated their colonial headquarters from Cape Coast in 1877. The British developed the city with a central business district (CBD) adjacent to the port and an open space separating this from the “Native Town” (Grant 2009). The colonial history of Accra, which ended with Independence in 1957, is still reflected in the landscape today: the once-isolated fishing villages of Chorkor and Teshie have been transformed into Accra neighborhoods and the Ridge, Airport Residential Area, Roman Ridge, and Cantonments neighborhoods where the Europeans used to live still maintain a shady, upscale character (Grant and Yankson 2003). Accra has a markedly diverse population, with representation from all of Ghana’s major ethnic groups and neighboring West African nationals, notably those from Togo, Nigeria, and the Sahel (Agyei-Mensah and Owusu 2009). The current city has few street names or addresses, and little urban planning. The development of Accra contrasts with the downtown-suburb pattern that dominates most Western cities and makes delineating neighborhoods a very different task.

Our overall research objective is to explore the relationship between health and place in Accra, Ghana, by quantifying neighborhood effects on health. One of the research tasks is to combine census and health measures to determine the spatial pattern of health outcomes within the city and relate our findings back to the community using meaningful geographic units. Therefore, our goal in this research is to create a map that allows us to incorporate information from both the census and surveys to create a neighborhood map that has meaning for the local population that provides a suitable level of aggregation to report health outcomes.

Methods

Study Area

The study area for this project is Accra, which is located on the coast of the Gulf of Guinea in the Atlantic Ocean. Within the Accra region, the specific area chosen for this study is the administrative unit known as the Accra Metropolitan Area (AMA). Responsibility for the health, welfare and governance of this urban population rests with the Accra Metropolitan Assembly. According to the March 2000 census, the metropolitan area comprised 1.6 million people (365,550 households) and is estimated to have reached over 2 million as of 2010. For the 2000 census, the Ghana Statistical Service delineated EAs for the entire country including 1,724 for Accra. EAs are akin to census tracts and follow recognizable boundaries such as roads and drainage canals. The individual EA units in Accra range in size from 0.0024 km² to 1.1 km² and previously only existed as hand drawn maps. These

data were digitized in a prior study (Weeks et al. 2007) and converted to a geographic information systems (GIS)-compatible shapefile format. The EAs were designed to each contain approximately 1,000 people, however in reality they range in population from 60 to 10,370 and average 986 people with a standard deviation of 618.4. These EAs were used as the building block for the neighborhood delineations so that no neighborhood boundary crossed an EA boundary; in other words, EAs nest within neighborhoods (Figure 1).

Neighborhood Creation

The creation of the neighborhood map followed a multi-step neighborhood definition process consisting of development of census block groups (EAs in this study), review of land use data, field visits, and observation in each of the communities (Weis *et al.* 2007). The first step of the process was to find maps of the city that could be used to help establish the names and rough outlines of the neighborhoods of Accra. This was not a straightforward task because large portions of Accra do not have street names or addresses, and detailed maps of the city are not readily available. The most useful map was a tourist map that could be bought at the local hotels and grocery stores that had general locations of neighborhoods. This map was scanned and then geo-referenced to the EA map, and then EAs were aggregated to form the local neighborhood from the tourist map. Similar to Weiss *et al.* (2007), the neighborhood boundaries were created, where possible, using natural barriers in the landscape including lines of transportation (major roads and railways) and drainage channels. This practice, combined with some preliminary field work, allowed us to generate an initial map of neighborhood boundaries. Our next step was to verify the accuracy of both neighborhood names on the tourist map and those on the map we generated. In order to do this, we traversed the neighborhoods where we had questions or difficulties in ascertaining borders.

Accra is a city where car ownership is relatively low and many residents commute by public transportation, either public minibuses (called *tro-tros*) or taxis. Since there are few street addresses, taxi drivers must know the general name or location of the neighborhoods where their customers want to go. Therefore, the research team used the local knowledge of taxi drivers in the neighborhood verification process. If the driver knew name and took us to the location we expected, this provided us with first step towards validating the neighborhood. Once there we would traverse the neighborhood and asked the local residents and shopkeepers questions, including ‘what is the name of this neighborhood?’ ‘Where does it end?’ ‘How do you define it?’ These preliminary field observations were tested against the expert knowledge of the Ghana Statistical Service (GSS), which is tasked with doing all census and survey work in Ghana. During our meetings we displayed our aggregated EA neighborhood shape file and covered points of uncertainty with them.

Concurrent with the (2008–2009) construction of the Accra neighborhood map, colleagues from Harvard and the University of Ghana were collecting data for the Women’s Health Survey of Accra Wave II (WHS-A-II). In addition to asking questions about general health conditions, this survey also asked what neighborhood the respondent lived in. Since each woman’s residential EA was also captured in this survey, it was possible to compare each woman’s self-reported neighborhood to the neighborhood we assigned her in the map. After going through the results, 954 women had responded to the neighborhood question covering 168 EAs across the city (Figure 1).

Results and Discussion

After walking most of the city of Accra and collaborating with local people and government officials alike, we aggregated the 1,724 EAs into 108 neighborhoods covering the entire AMA (Neighborhood Map). This map was created by dissolving the EAs into the

neighborhoods using ArcMap 10.0. Neighborhoods range in size from a single EA particularly in the northwest portion of the AMA to 74 EAs in the densely populated center city areas, with an average of 16 EAs per neighborhood.

Determining neighborhood boundaries was relatively straightforward in some areas and more difficult in others. In general, the areas easiest to define were in the older parts of the city that were established prior to or during colonial times. Many of these neighborhoods were on some the original maps of Accra (Grant 2009) and include the fishing villages of Chorkor, Teshie, La, and Jamestown that existed prior to the British moving the capital to Accra. In many cases these particular neighborhoods are inhabited by the people from the Ga-Dangme ethnic group that were the original settlers of Accra (Agyei-Mensah 2009). The Ga-Dangme are a fishing people and have stayed along the coast and continue to fish today. Other neighborhoods that were straightforward to define include those laid out during colonial times such as Roman Ridge and Cantonments, which were established by the British and have a more planned feel to them. Other neighborhoods with more straightforward boundaries included some of the notorious slums of Accra including Nima, Sabon Zongo and Old Fadama (known locally as ‘Sodom and Gomorrah’). Overall, many of the areas that were straightforward to map had substantial physical features such as roads, drainage canals (the Odaw river), or the ocean shaping their boundaries.

Other more recently established neighborhoods outside the downtown core were more difficult to define precisely. These areas tended to be on the outer edges of the AMA or were areas of infill into the open space that occurred after the colonial period. Examples of these neighborhoods include Nii Boy Town in the northwest, newly-settled Spintex in the northeast and Mamprobi, Dansoman, and New Russia (the last named after a failed Soviet project) in the western part of the city. These neighborhoods are generally less dense and follow more of a sprawling suburban model with informal pockets of housing and commercial activities interspersed.

Once the difficulties in mapping these ambiguous areas were overcome, the final neighborhood map was compared to survey data from the WHSA-II. The results of this comparison indicate that our neighborhood map attributed 71 percent of the EAs to the same neighborhoods as the self-reported Women’s Health Survey data and is mapped in Figure 2. This indicates relatively good agreement between our mapped neighborhoods and locals’ description of the city. While we were incorrect for approximately 30 percent of the neighborhoods, a leading cause was open-ended nature of the question. Many of the respondents named areas that were smaller than the neighborhood size we assigned or used an alternative name for the same area. In some areas there was confusion between the neighborhood name and the AMA sub-district name, while in others indigenous sub-neighborhood designations were used. In Cantonments, for instance, a number of respondents mentioned the police station as their neighborhood name. While this was not their proper neighborhood, residents use this landmark for getting to and from the area in which they live. After some research we learned that the police station, was in fact the Cantonments police station. While we had the general area correct, the respondents had decided to use a smaller unit to describe their neighborhood. In addition, some areas had two different names, such as New Mamprobi which also went by the name of Banana Inn. When walking through this neighborhood one would see both names and the correct neighborhood name would depend on who you talked to. Both answers could appear to be correct. These findings illustrate the potentially fuzzy nature of neighborhood boundaries. Some neighborhoods have “crisp” boundaries recognized by a very high percentage of residents, whereas other neighborhoods have “soft” boundaries that are less likely to be agreed upon by the local population. As indicated in Figure 2, the spatial pattern does not conform to the

expectation in which older, core areas of the city have less fuzzy boundaries than do newer areas in the more outlying areas of the city.

Summary and Conclusions

In summary, we have produced a neighborhood map of the Accra Metropolitan Area where the boundaries we defined were based on the general vernacular name of the area. Persons living in these neighborhoods might disagree with the exact boundary that we created, however these neighborhoods represent the best fit for a vernacular area commonly known and used by residents. The neighborhood map was created without a specific health outcome in mind, and instead is a testable unit to ascertain how well a field-based investigation can produce a map useful for health studies. This may be advantageous in case-study style projects focusing on a range of health issues within a city, where it may not be feasible to create a different neighborhood map for each health outcome being investigated. This map has already been used by several researchers exploring income and health disparities within the city (Engstrom *et al.* 2011, Weeks *et al.* in press).

When defining neighborhoods, one of our observations for Accra was the impact of history on both the neighborhood names and boundary delineation. In many cases the colonial development of the city is still intact in terms of both the names and the character of the neighborhoods in question.

This field-based methodology is a relatively accurate way to delineate neighborhoods in developing urban areas; however it is very time and labor intensive. While requiring significant time in the field walking the streets of the city and interviewing local residents, this research provided us with a rich knowledge of the variations in living conditions that exist across this rapidly developing city. Such variations may be affecting spatial variations in health outcomes and can provide us with substantial insight as to both the dynamics of the city and a greater appreciation for the warm and friendly people of Accra.

The original creation of this map was performed in ArcGIS 9.3. The most recent iterations and cartographic work was performed in ArcGIS 10.0.

Map Design

This map was created in various versions of ArcGIS from 9.3 to 10.0 as it took us a number over three years to put it together. The majority of the time spent on this map was the walking of the neighborhoods and speaking to the local population. Overall, between the co-authors we spent over three months in the field meeting and talking with people and walking the streets of Accra.

The people of Accra were very helpful in describing their neighborhoods and helping us to understand where the boundaries were. Many of the people that we spoke with had a very good sense of space and place. When making this map for display purposes, the most difficult part was creating a color and labeling scheme that was easy to read by the user. This was due to the fact of the varying size of neighborhood units and large number of units that were touching one another. The colors chosen are only used to identify different neighborhoods and do not represent any gradients or differences between the neighborhoods.

Acknowledgments

This research was supported by Grant Number R01HD054906 from the Ethel Kennedy Shriver National Institute of Child Health and Human Development. The content is solely the responsibility of the authors and does not

necessarily represent the official views of the National Institute of Child Health and Human Development or the National Institutes of Health.

References

- Agyei-Mensah S, Owusu G. Segregated by Neighbourhoods? A Portrait of Ethnic Diversity in the Neighbourhoods of the Accra Metropolitan Area, Ghana. *Population, Space and Place*. 2009;10.1002/psp.551
- Chaskin RJ. Perspectives on neighborhood and community: a review of the literature. *Social Service Review*. 1997; 7:521–47. <http://dx.doi.org/10.1086/604277>.
- Roux, Diez. Investigating Neighborhood and Area Effects on Health. *American Journal of Public Health*. 2001; 91(11):1783–1789. <http://dx.doi.org/10.2105/AJPH.91.11.1783>. [PubMed: 11684601]
- Diez Roux AV. Residential environments and cardiovascular risk. *J Urban Health*. 2003; 80:569–89. <http://dx.doi.org/10.1093/jurban/jtg065>. [PubMed: 14709706]
- Diez Roux AV, Merkin S, Arnett D, et al. Neighborhood of residence and incidence of coronary heart disease. *N Engl J Med*. 2001; 345:99–106. <http://dx.doi.org/10.1056/NEJM200107123450205>. [PubMed: 11450679]
- Engstrom, R.; Ashcroft, E.; Jewell, H.; Rain, D. Using Remotely Sensed Data to Map Variability in Health and Wealth Indicators in Accra, Ghana. *Joint Urban and Remote Sensing Event Proceedings; Munich, Germany*. 2011. p. 145-148.
- Gephart, MA. Neighborhoods and communities as contexts for development. In: Brooks-Dunn, J.; Duncan, GJ.; Aber, JL., editors. *Neighborhood poverty: context and consequences for children*. Vol. 1. New York: Russel Sage Foundation; 1997. p. 1-43.
- Grant R, Yankson P. Accra profile. *Cities*. 2003; 20(1):65–74. [http://dx.doi.org/10.1016/S0264-2751\(02\)00090-2](http://dx.doi.org/10.1016/S0264-2751(02)00090-2).
- Grant, R. *Globalizing City: The Urban and Economic Transformation of Accra, Ghana*. Syracuse, N.Y: Syracuse University Press; 2009. p. 202
- Mitchell, Richard; Dorling, Danny; Shaw, Mary. *Population Production and Modelling Mortality--An Application of Geographic Information Systems in Health Inequalities Research*. *Health & Place*. 2002; 8:15–24. [http://dx.doi.org/10.1016/S1353-8292\(01\)00032-6](http://dx.doi.org/10.1016/S1353-8292(01)00032-6). [PubMed: 11852260]
- Montgomery, Mark; Hewett, Paul C. Urban Poverty and Health in Developing Countries: Household and Neighborhood Effects. *Demography*. 2005; 42:397–425. <http://dx.doi.org/10.1353/dem.2005.0020>. [PubMed: 16235606]
- Morland K, Wing S, Diez Roux AV. The contextual effect of the local food environment on resident's diets: the Atherosclerosis Risk in Community study. *Am J Public Health*. 2002; 92:1761–67. <http://dx.doi.org/10.2105/AJPH.92.11.1761>. [PubMed: 12406805]
- O'Campo PJ, Xue X, Wang M, Caughy MO. Neighborhood risk factors for low birthweight in Baltimore: a multilevel analysis. *Am J Public Health*. 1997; 87:1113–18. <http://dx.doi.org/10.2105/AJPH.87.7.1113>. [PubMed: 9240099]
- Pickett L, Pearl M. Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *Journal of Epidemiology and Community Health*. 2001; 55:111–122. <http://dx.doi.org/10.1136/jech.55.2.111>. [PubMed: 11154250]
- Rytönen, Mika; Rusanen, Jarmo; Nayha, Simo. Small-Area Variation in Mortality in the City of Oulu, Finland, During the Period 1978–1995. *Health & Place*. 2001; 7:75–79. [http://dx.doi.org/10.1016/S1353-8292\(00\)00040-X](http://dx.doi.org/10.1016/S1353-8292(00)00040-X). [PubMed: 11470221]
- Santos S, Chor D, Werneck. Demarcation of local neighborhoods to study relations between contextual factors and health. *International Journal of Health Geographics*. 2010; 9:34. <http://dx.doi.org/10.1186/1476-072X-9-34>. [PubMed: 20587046]
- Weiss L, Ompad D, Galea S, Vlahov D. Defining Neighborhood Boundaries for Urban Health Research. *American Journal of Preventive Medicine*. 2007; 32(6S):S154–S159. <http://dx.doi.org/10.1016/j.amepre.2007.02.034>. [PubMed: 17543706]
- Weeks J, Getis A, Stow D, Hill A, Rain D, Engstrom R, Stoler J, Lippitt C, Jankowska M, Lopez AC, Coulter L, Ofiesh C. Connecting the Dots between Health, Poverty, and Place in Accra, Ghana. *Annals of the Association of American Geographers*. (In Press).

- Weeks JR, Hill AG, Stow D, Getis A, Fugate D. Can You Spot a Neighborhood From the Air? Defining Neighborhood Structure in Accra, Ghana. *GeoJournal*. 2007; 69:9–22. [PubMed: 19478993]
- Yen I, Kaplan G. Poverty area residence and changes in physical activity level: evidence from the Alameda County Study. *Am J Public Health*. 1998; 88:1709–12. <http://dx.doi.org/10.2105/AJPH.88.11.1709>. [PubMed: 9807543]

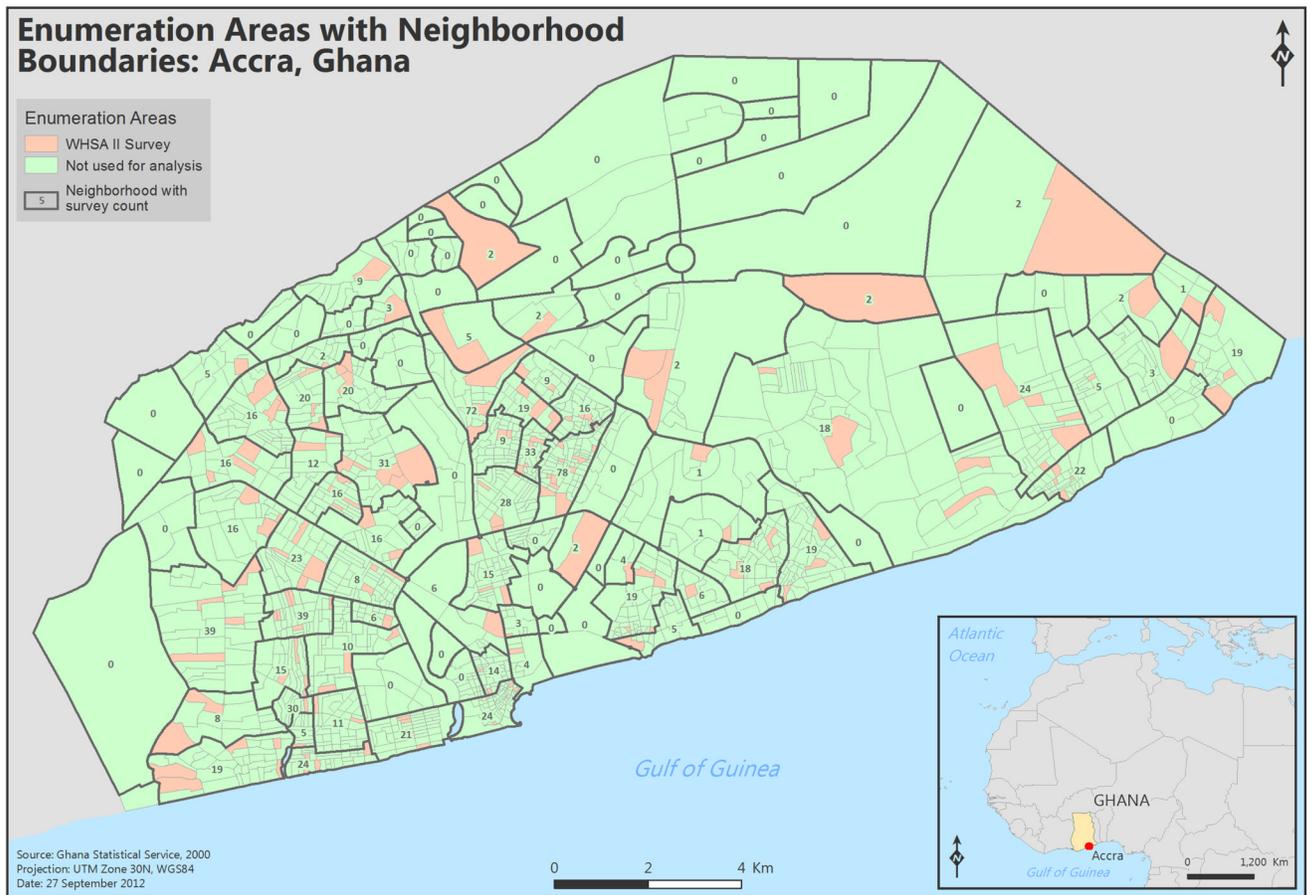


Figure 1. Map of the 1,724 Enumeration Areas with the neighborhood boundaries and the number respondent locations from the Women’s Health Survey of Accra II for each of the neighborhoods within the Accra Metropolitan Area.

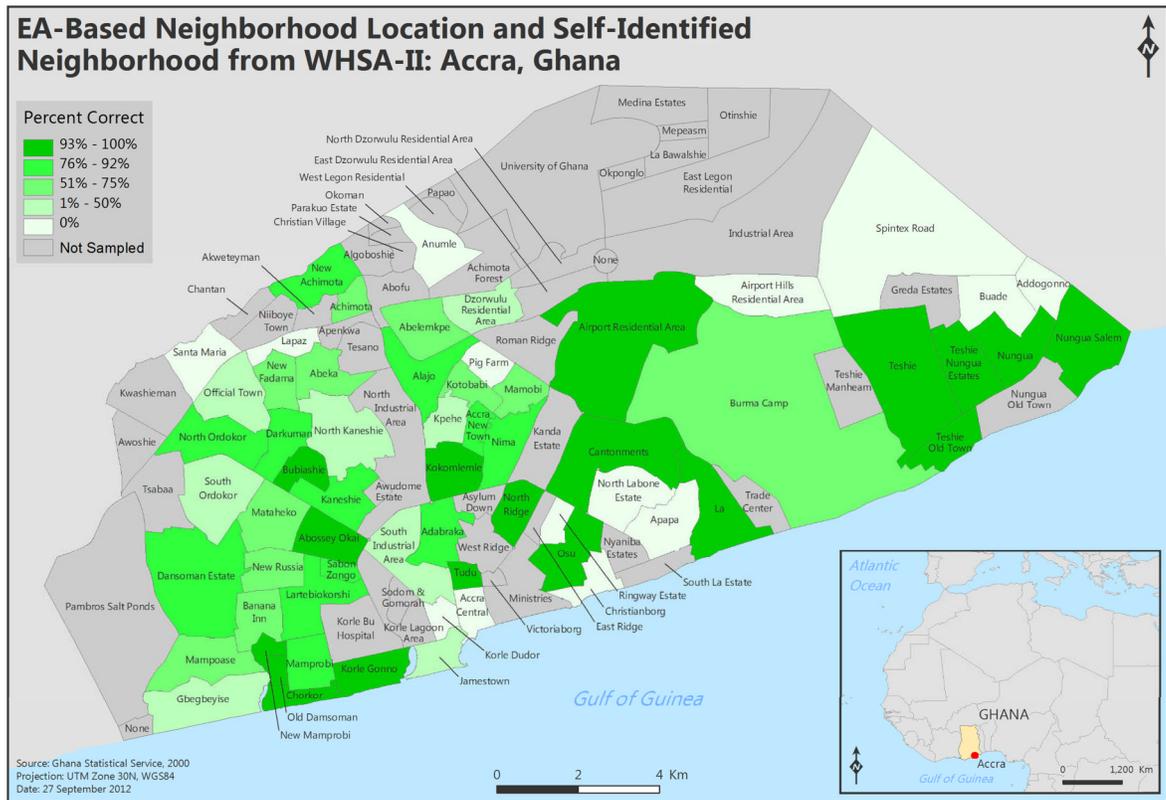


Figure 2. Map of Enumeration Area based location and percent correct of self-identified neighborhood from the Women’s Health Survey of Accra II data. Data were stratified using natural breaks.