Where do overweight women in Ghana live? Answers from exploratory spatial data analysis

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Abstract

Contextual influence on health outcomes is increasingly becoming an important area of research. Analytical techniques such as spatial analysis help explain the variations and dynamics in health inequalities across different context and among different population groups. This paper explores spatial clustering in body mass index among Ghanaian women by analysing data from the 2008 Ghana Demographic and Health Survey using exploratory spatial data analysis techniques. Overweight was a more common occurrence in urban areas than in rural areas. Close to a quarter of the clusters in Ghana, mostly those in the southern sector contained women who were overweight. Women who lived in clusters where the women were overweight were more likely to live around other clusters where the women were also overweight. The results suggest that the urban environment could be a potential contributing factor to the high levels of obesity in urban areas of Ghana. There is the need for researchers to include a spatial dimension to obesity research in Ghana paying particular attention the urban environment.

Introduction

Over the last decade contextual influences on health outcomes has become an important area of research in many disciplines including public health, epidemiology, sociology and geography.[1] Contextual effects research has advanced in the western world, however, in developing countries, this is still a budding area. Contextual influences represent a broad range of factors including things in the environment, the characteristics of a place and the characteristics of people living in a particular place, usually a geographically defined or spatially bounded location.[2-4] Recent advancement in statistical and spatial methods of analysis allows researchers to investigate spatial effects beyond the regional and rural/urban divide which has dominated research endeavours until recently.[5-7]

Body mass index (BMI) as a measure of obesity has been found to be influenced by the context within which people live.[4,8] Like most countries in the developing world, BMI values in Ghana have been observed to be on the increase resulting in higher rates of overweight and obesity over time.[9,10] Research on obesity in Ghana has largely explored individual characteristics and lifestyle behaviours in relation to obesity.[10-12] However, despite the rising prevalence of obesity in Ghana, very little attention has been given to research that explores spatial dimensions to BMI in Ghana. In this paper, the author explores the spatial patterning of BMI among Ghanaian women. The study specifically investigates spatial autocorrelation in BMI using the cluster as the spatial unit of observation.

Materials and Methods

Sources of data

This study makes use of secondary data from the 2008 Ghana Demographic and Health Survey (GDHS). The demographic and health survey (DHS) incepted in 1984 is conducted periodically (usually every five years) in developing countries to plan, monitor and evaluate population, health and nutrition programs.[13] In the DHS, data is collected on demographic and health indicators. Data for the 2008 survey, which is the fifth round in the series for Ghana was collected by the Ghana Statistical Service in conjunction with ICF Macro International.

The data files in the 2008 GDHS include a geographic positioning system (GPS) data file and individual data files among others. The GPS data contains geo-referenced locations (longitude and latitude) of clusters to which individual respondents who were part of the survey belong to while the individual data files contain demographic, health and socio-economic status information on individual respondents who were interviewed. The individual data files also contain the cluster numbers, which makes it possible to link the individual data files and the GPS data files.

The 2008 GDHS GPS data file contains the cluster numbers and longitude and latitude co-ordinates for 412 clusters located throughout the whole of Ghana. The individual women's data file contains information on 4916 women aged between 15 and 49 years. For the purposes of this study, women who reported being pregnant and those who had missing or flagged BMI values were excluded from the analysis. The final sample size included 4454 women who were not pregnant at the time of the survey and who had valid BMI values.

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Contributions: FAAD conceptualised and designed the study. The author also performed all the analysis and prepared the manuscript.

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Analysis for this study was carried out at the cluster level. Information in the individual women's data file was thus aggregated to the cluster level. Some clusters in the GPS data file had zero longitude and latitude co-ordinates. These clusters were therefore not included in the analysis. The final analysis for the study was carried out on a total of 404 clusters that had longitude and latitude co-ordinates and valid BMI values for the women belonging to these clusters.

Variables

Mean body mass index per cluster

Mean BMI per cluster, which was obtained by finding the average BMI of the women in a cluster was used as the dependent variable. The dependent variable was treated as a categorical variable and the categorisation was done based on the standard WHO BMI cut-off points.[14] The categories of the dependent variable were; normal weight (BMI; 18.50-24.99 kg/m^2), overweight (BMI; 25.00-29.99 kg/m^2) and obese (BMI≥30.00 kg/m^2).

Software

Several softwares were employed at various stages of the analysis. The Statistical Package for Social Sciences (SPSS version 18.0, SPSS Inc., Chicago, IL, USA) was used to aggregate the information contained in the individual women's data file from the individual level to the cluster level. The cluster level data file was then converted into a data base file (dbf). The GPS data and the aggregated cluster level data were both converted to text files. The GPS text file was converted to a shape (shp) file in Open Geoda. The aggregated dbf was joined to the GPS shape file in ArcGIS (9.3.1) using cluster number as a common identifier in both files. The joining of the two data files resulted in one shape file, which was used for the final analysis. Weight creation, descriptive and exploratory analysis were all performed in Open Geoda.

Methods of analysis

The cluster distribution of normal weight and overweight across the country was mapped with ArcMap in ArcGIS using graduated colours. The dependent variable was explored in Open Geoda using a number of descriptive and exploratory tools including a histogram, a box plot, and a cartogram. The presence of spatial clustering was determined using the local spatial autocorrelation (LISA) statistic and the univariate Moran's I statistic.[15]

Results

Mean body mass index distribution by cluster

The regional boundaries of the administrative regions in Ghana showing the location of the clusters are shown in Figure 1. The analysis revealed that overweight among women is a more common phenomenon in southern Ghana than in northern Ghana. However, there were a few clusters in the northern half where the women were overweight on average. One of these clusters in the Upper West region had its mean BMI value falling in the obese category of the WHO BMI classification (Table 1). The mean BMI of women in 315 clusters (constituting approximately 78% of all the clusters) was in the normal range (Figure 2).

On the other hand, the mean BMI of women in 87 clusters was in the overweight category while in 5 clusters the mean BMI lies within the obese category. The results indicate that almost a quarter of the clusters in Ghana contain women who are mostly overweight on average. A box plot at a hinge value of 1.5 revealed that the mean BMI of women in six clusters were high outliers with all but one of them falling in the obese category (Table 1). Five out of the six clusters were located in the southern part of Ghana with the other one being in the northern part, precisely the Upper West region (Table 1).

Spatial autocorrelation

The analysis revealed mostly local spatial clustering in overweight. The univariate Moran's I statistic and the univariate LISA statistic both yielded a value of 0.1817 ($P<0.01$) (Figure 3). This value remained the same for both a queen and a rook first order contiguity weight matrix. The queen weight matrix was thus used for the rest of the analysis. Most of the clusters in the middle and northern sectors of Ghana showed significant low-low spatial autocorrelation (Figure 4). On the other hand, some clusters in the southern half exhibited high-high spatial autocorrelation. The clusters in the southern half that showed high-high spatial auto-correlation were mostly in the Ashanti, Eastern, Central, Volta and Greater Accra regions.

Discussion

This paper sought to explore spatial variation in BMI among Ghanaian women. The results of the analyses suggest that there is spatial variation in BMI by cluster among women in Ghana. The results show a North-South divide, while most of the clusters in the southern half of Ghana have mean BMI values in the overweight category only a few of the clusters in the Northern half have mean BMI values in the overweight category. Also, while clusters in the Northern half showed low-low

Table 1. Cluster, regional distribution and body mass index categorisation by mean body mass index per cluster.

Cluster number	Administrative region	Mean BMI (kg/m^2)	BMI categorisation
175	Eastern	29.45	Overweight
169	Eastern	30.25	Obese
100	Greater Accra	30.17	Obese
44	Central	30.30	Obese
219	Ashanti	33.36	Obese
388	Upper West	30.87	Obese

Computed from GDHS, 2008. BMI, body mass index.

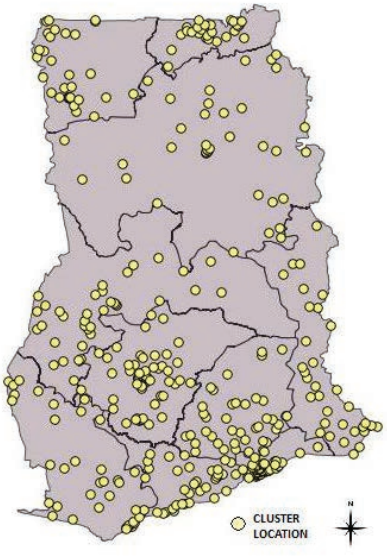

Figure 1. Map of Ghana showing regional boundaries and spatial distribution of clusters. Generated from GDHS, 2008.

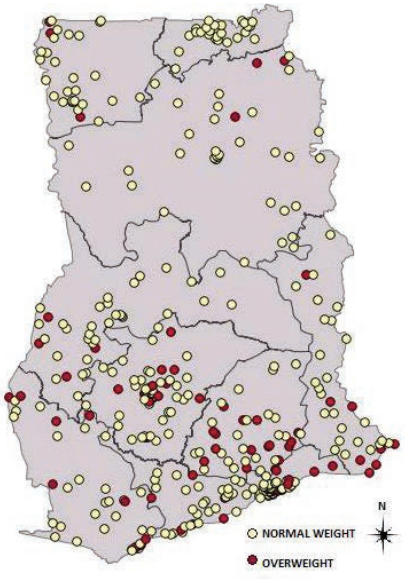

Figure 2. Distribution of normal weight and overweight by cluster among Ghanaian women showing regional boundaries.

spatial autocorrelation clusters in the southern half showed high-high spatial autocorrelation.

The distribution of overweight by clusters as revealed by the analysis lends support to research findings, which indicate that overweight and obesity are more common in urban areas of developing countries including Ghana.[10-12,16] The pattern of spatial autocorrelation indicate that women in the Northern sector are more likely to have low BMI values and they are more likely to be surrounded by other women who have low BMI values as well. The reverse is the case in the Southern sector where overweight women are more likely to live around women who also have high BMI values (mostly in the overweight category).

The Southern half of Ghana is generally more urban than the Northern half. Being the capital of Ghana, the Greater Accra region is also the most urbanised region[12] in Ghana followed by the Ashanti region. Urban areas of developing countries are characterised by fast paced economic development.[17] These urban areas are also undergoing rapid transitions including nutritional, economic and epidemiological transitions.[18] With these characteristics it is possible that the environment in urban areas is obesogenic and this constitutes a risk for overweight and obesity for women who live in and around such areas. This could be a possible contributing factor to the high rates of overweight and obesity and the spatial clustering of high BMI values among women in the urbanised areas of Ghana.

High BMI among women in Ghana is a more common occurrence in the Greater Accra region.[10-12] Recent findings however indicate that BMI values among Ghanaian women are on the increase among women across all the ten regions of Ghana.[10] The results of the present study lend support to these earlier findings and also reveal certain findings that call for attention. Firstly, positive spatial autocorrelation in regions such as the Eastern, Central and Volta regions suggests that there are places in these regions where the BMI of the women are high. Secondly, significant positive spatial autocorrelation in urban areas like Accra supports the research findings[19] and the World Health Organisation's report that obesity is more common in urban areas of developing countries.[16]

A number of plausible factors could possibly explain what is going on in terms of the spatial distribution of BMI among Ghanaian women. It could be that women who have high BMI values are found in a particular place (in urban areas). This could happen through a process of selection, which results in women who have high BMI values residing around each other. It could also be that the women who have high BMI values also have similar characteristics, which predispose them to having high BMI val-

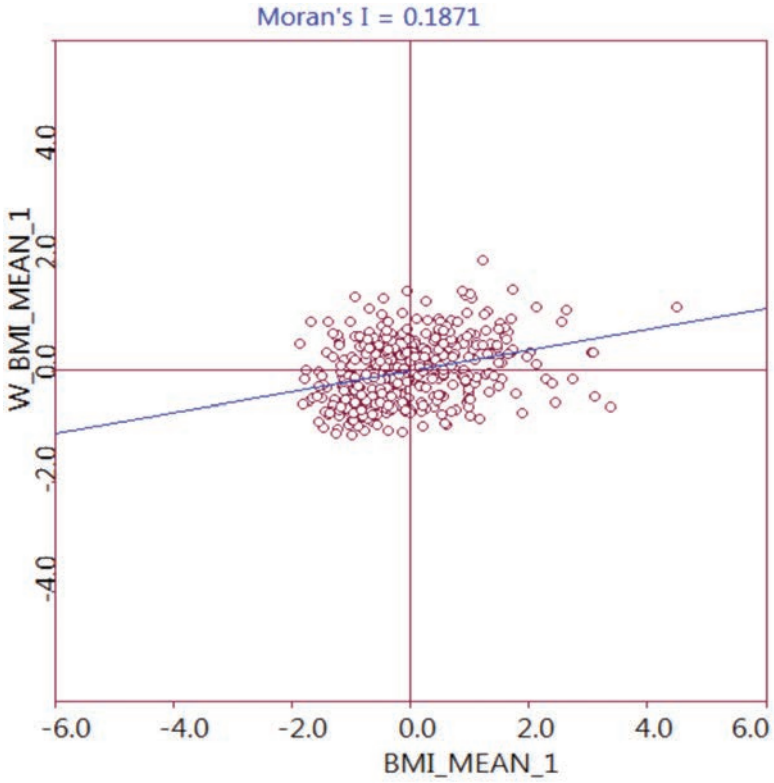

Figure 3. Moran's scatter plot of mean body mass index by cluster.

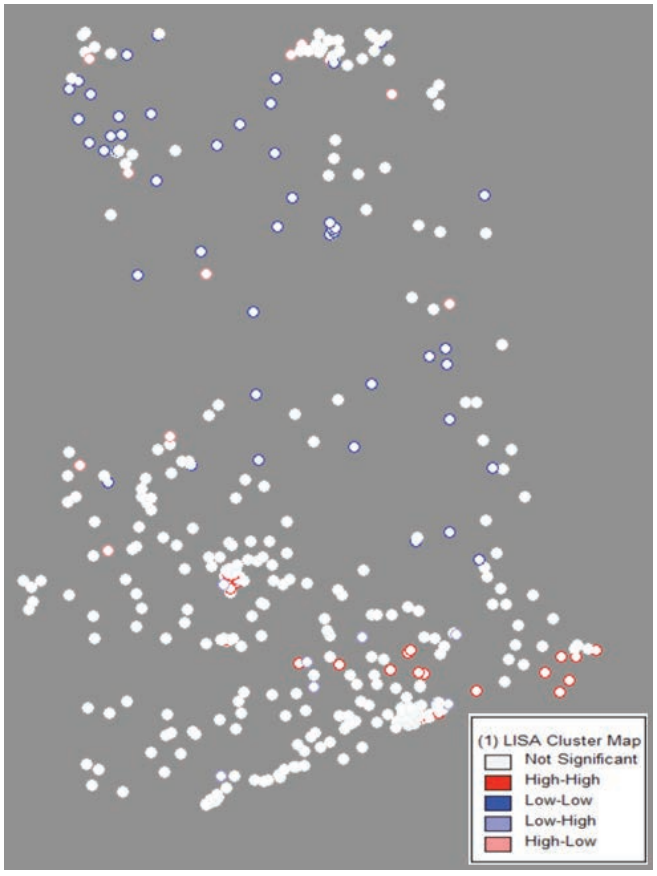

Figure 4. LISA significance plot depicting spatial autocorrelation in mean body mass index by cluster among Ghanaian women.

ues. Alternatively, the characteristics or attributes of the place in which these women live (urban areas in this case) probably constitute a risk factor for high BMI values for these women since an environment that promotes high caloric intakes while discouraging physical activity increases the risk of obesity.[20,21] The urban environment in developing countries is increasingly becoming obesogenic[17] due to globalisation and economic growth.[22]

Conclusions

This study provides preliminary results, which suggest spatial clustering in BMI among women in Ghana. The study draws attention to the fact there is the need to incorporate a spatial dimension to obesity research in Ghana and also provides a basis for further research into the likely factors that explain the spatial variation in BMI among Ghanaian women. Environmental contributors to obesity especially in urban areas should also be investigated incorporating variables such as population density, area deprivation and infrastructural distribution among others. Findings from such studies will provide empirical evidence, which will help broaden our understanding of the dynamics of obesity in Ghana that will inform the formulation of appropriate policies to help tackle the problem of increasing prevalence of obesity among women across the country.

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