Where Do Overweight Women In Ghana Live? Answers From Exploratory Spatial Data Analysis

Abstract

Recent findings in the health literature indicate that health outcomes including low birth weight, obesity and non-communicable disease conditions are influence by the context within which people live. Even though the prevalence of obesity is on the increase in Ghana, the possibility of a spatial dimension to the problem remains under researched. This paper explores spatial clustering in body mass index (BMI) among Ghanaian women.

The paper uses data from the 2008 Ghana Demographic and Health Survey which was analysed using exploratory spatial data analysis (ESDA) techniques.

The southern half of Ghana had more overweight women than the northern half. Women who lived in clusters where the women were overweight were more likely to live around other women who were also overweight. Similarly women who were of normal weight were more likely to be surrounded by other women who were of normal weight.

The results indicate 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 and sociology. 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 (Pickett and Pearl, 2001; Ross et al, 2004). Contextual effects research has advanced in the western world, however, in the developing countries, this is still a budding area. 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.

Body mass index (BMI) as a measure of obesity has been found to be influenced by the context within which people live (Pickett and Pearl, 2001; Roux, 2001). 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. Research on obesity in Ghana has largely explored individual characteristics and lifestyle behaviours in relation to obesity (Dake et al, 2010; Biritwum et al, 2005; Amoah, 2003). 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.

Methodology

Sources of data

This study makes use of secondary data from the Ghana Demographic and Health Survey (GDHS), 2008 collected by the Ghana Statistical Service in conjunction with IFC Macro International. The demographic and health survey periodically (usually every five years) collect demographic and health information on developing countries. The 2008 GDHS is the fifth round in the series. The GDHS data files include a geographic positioning system (GPS) data file and individual data files. The GPS data contains geo-referenced locations (longitude and latitude values) of clusters to which individual respondents who are part of the survey belong to. The individual data files contain demographic, health and socio-economic status information on individual respondents who were interviewed in the survey. 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 values for 412 clusters located throughout the whole of Ghana. The individual women's data file contains information on 4,916 women. 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 includes 4,454 women who were not pregnant at the time of the survey and who had valid BMI values. Information in the individual women's data file was aggregated to the cluster level. Some clusters in the GPS data file had zero longitude and latitude values. These clusters were thus not included in the analysis. The final data set used for this analysis includes a total of 404 clusters that had valid information on all the variables of interest.

Variables

- **Mean BMI per cluster**

Mean body mass index (BMI) per cluster which was obtained by aggregating the BMI of all the women in the 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. The categories of the dependent variable were normal weight (BMI; 18.50 – 24.99kg/m^2) and overweight (BMI; 25.00 – 29.99kg/m^2) and obese (BMI ≥ 30.00kg/m^2).

Software

A number of different software were employed at various stages of the analysis. The Statistical Package for Social Sciences (SPPSS) version 18.0 was used to aggregate the information contained in the individual women's data file to the cluster level. The cluster level data file was 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 data base file 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 both data sets 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

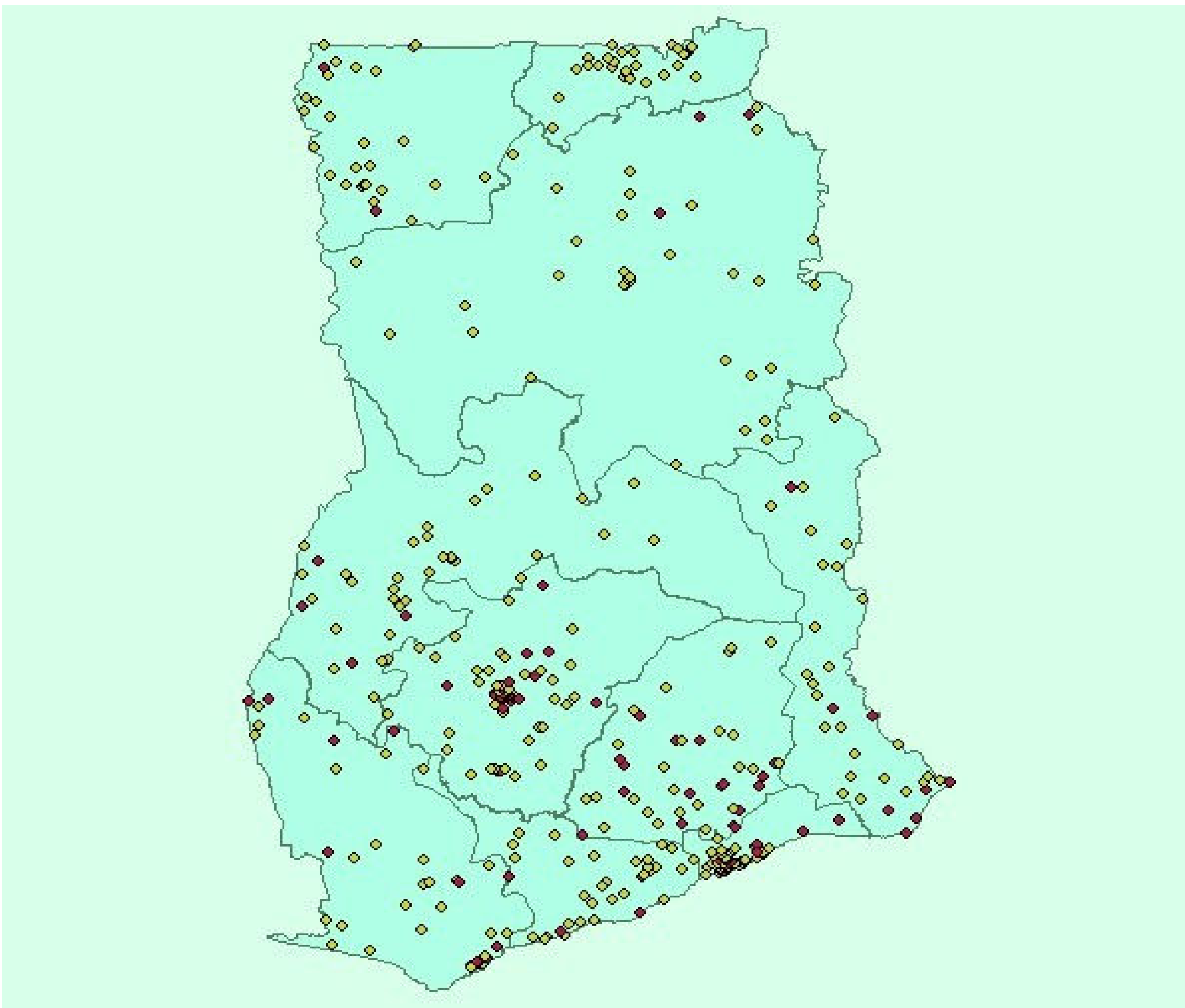
The cluster distribution of normal weight and overweight across the country was mapped with ArchMap using graduated colours. The dependent variable was explored using a number of descriptive and exploratory tools including a histogram, a box plot, and a cartogram. The presence of spatial clustering was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

Results

Mean BMI distribution by cluster

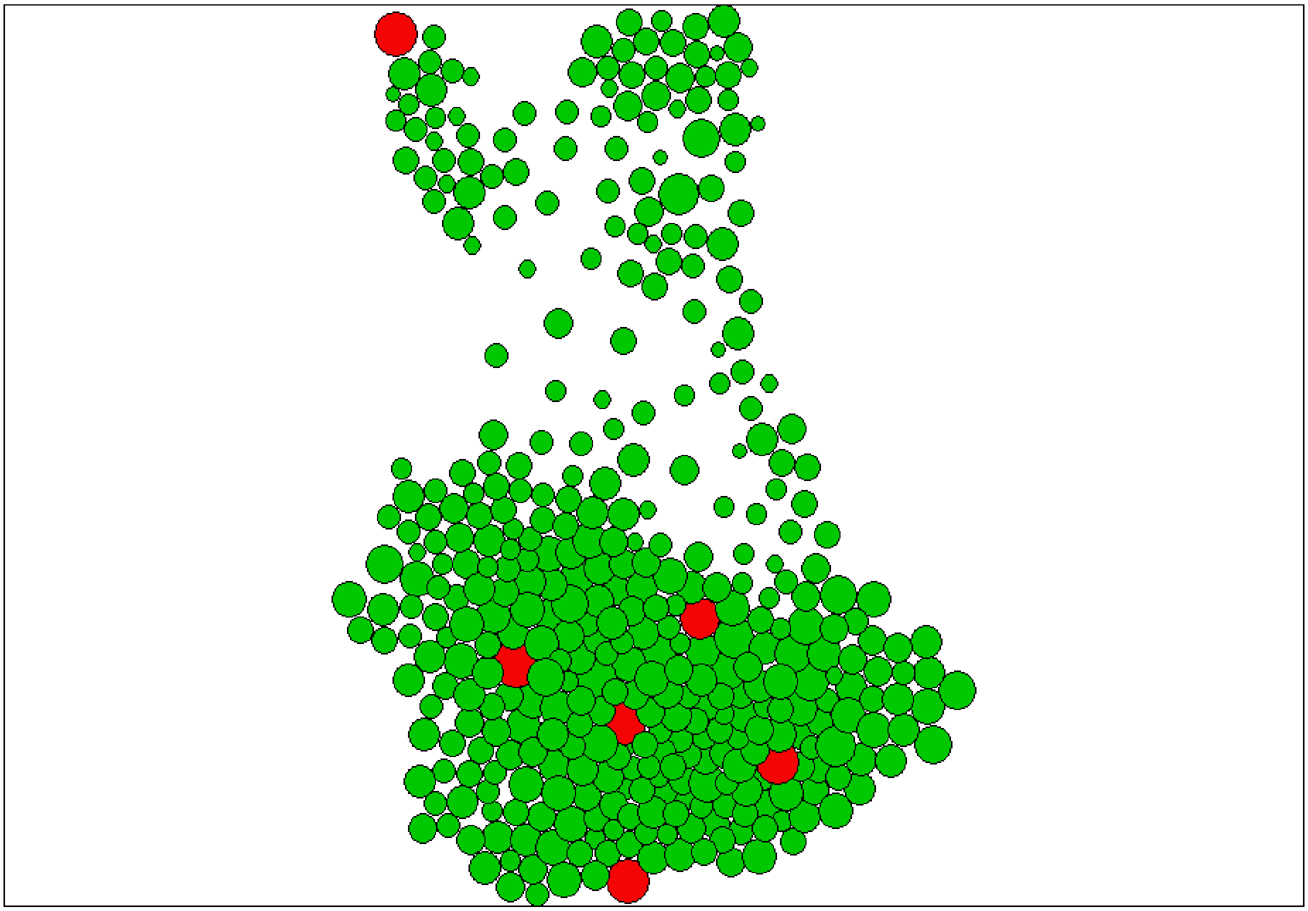
The analysis revealed that being overweight is a common phenomenon in Southern Ghana than in northern Ghana. However, there were a few clusters in the Northern half where the women were overweight on average. One of these clusters in the Upper West region had its mean BMI value falling in the obese category 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 1). On the other hand, the mean BMI of women in 87 clusters was in the overweight category while in 2 clusters the mean BMI falls within the obese category. The results indicate that almost a quarter of the DHS 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. Five out of the six clusters are located in the southern part of Ghana and the other one in the northern part, precisely in the Upper West region (Table 1, Figure 2).

Figure 1: Distribution of normal weight and overweight among Ghanaian women by DHS cluster



Key: Yellow colour denotes Normal weight, Red colour denotes Overweight
Source: Generated from GDHS, 2008

Figure 2: Cartogram of mean BMI per cluster showing high outliers



Key: Red colour denotes high outliers, Green colour denotes Normal clusters

Note: Circle size proportional to mean BMI value of cluster

Table 1: Cluster, regional distribution and BMI categorisation by mean BMI 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

Source: Computer from GDHS, 2008

Spatial autocorrelation

The analysis revealed both global and local spatial clustering. 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. Using a distance based weight matrix yielded lower Moran's I and LISA statistic values. 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.

Figure 3: Moran's scatter plot of mean BMI by DHS cluster

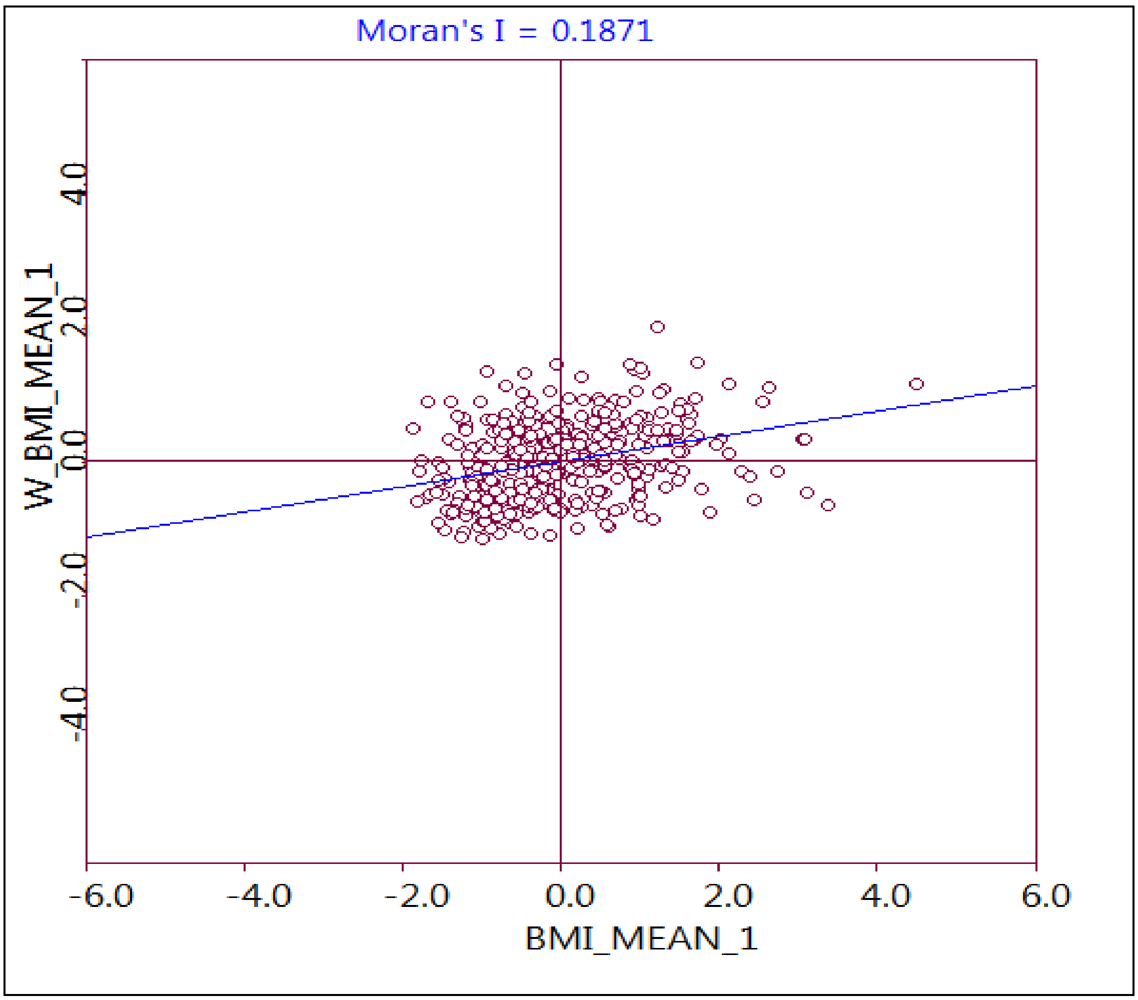
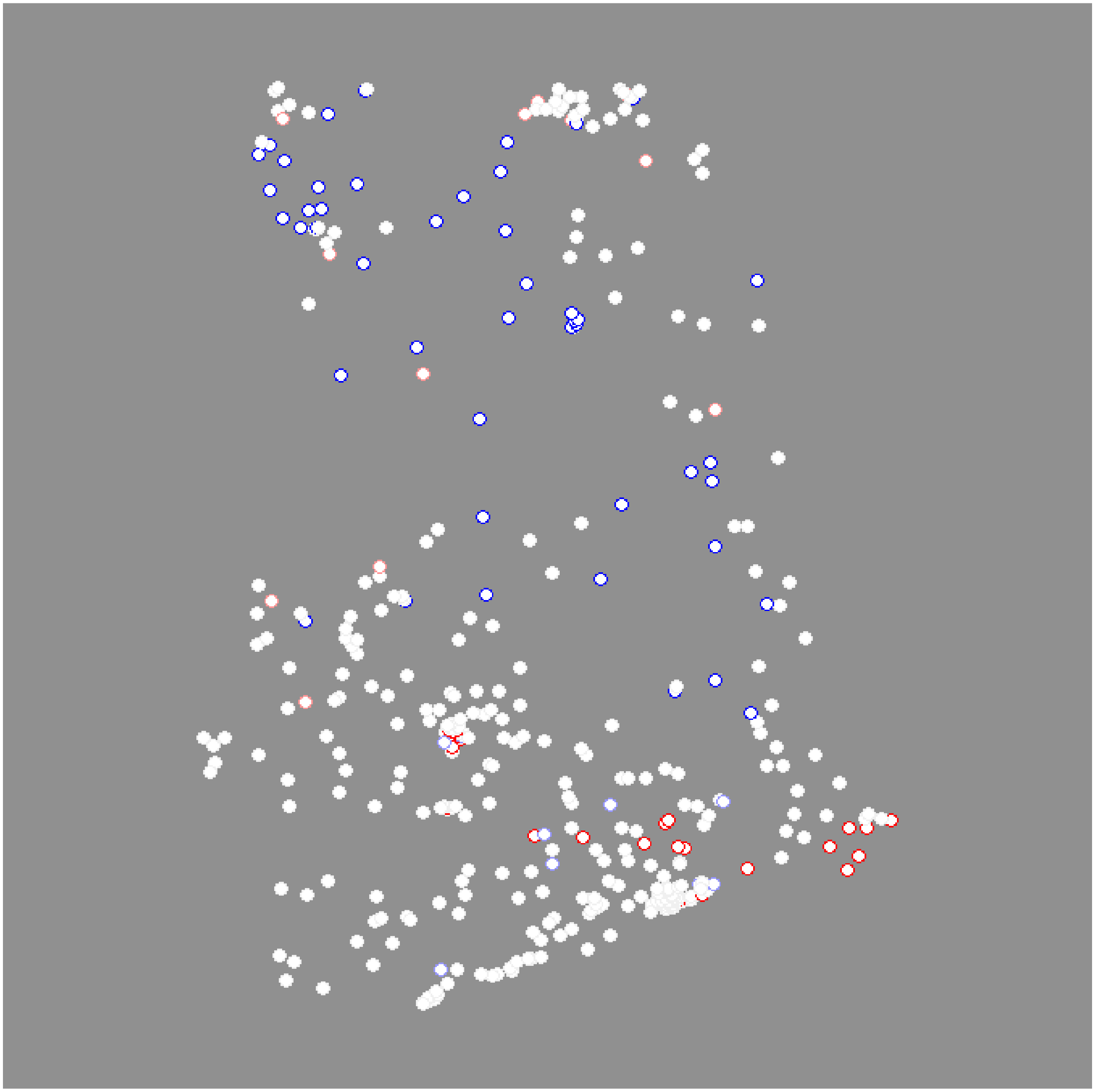


Figure 4: LISA significance plot depicting spatial autocorrelation in mean BMI by DHS cluster



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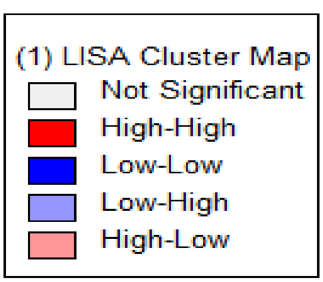

Discussion

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 clear 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 spatial auto-correlation clusters in southern showed high-high spatial auto-correlation.

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 like Ghana (WHO, 2006; Dake et al, 2010). The pattern of spatial auto-correlation 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, overweight women are more likely to live around women who also have high BMI values.

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 in Ghana followed by the Ashanti region. Urban areas of developing countries are characterised by fast paced economic development (Popkin and Gordon-Larsen, 2004). These urban areas are also undergoing rapid transitions including nutritional, economic and epidemiological transitions (Popkin, 1997). 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 high rates of overweight/obesity and the spatial clustering of high BMI values among women in the urbanised areas of Ghana. There is the need for further research into this phenomenon and the underlying mechanism that predicates this pattern. Such a study will provide the empirical evidence that will inform the formulation of appropriate policies to help tackle the problem of obesity especially in urban areas.

Conclusion

This study provides preliminary results which suggest potential spatial clustering in BMI among Ghanaian women. The study draws attention to the fact there is the need to incorporate a spatial dimension to obesity research in Ghana. The DHS cluster as used in this analysis is more heterogeneous than homogeneous and could have affected the results. It is therefore recommended that the geographic scale of measurement be made more local to ensure homogeneity and to allow for place specific research rather than aggregating places into one. Environmental contributors to obesity especially in urban areas should also be investigated.

Next steps

The next step of this research will be to investigate spatial dependence in factors that influence obesity. The study will also explore the influence of demographic, socio-economic and lifestyle behaviours on BMI in a spatial analysis using techniques such as spatial lag regression and geographically weighted regression.

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