Contact: idris.guessous@hcuge.ch

Spatial Dependence of Body Mass Index: Geneva, Switzerland

Idris Guessous[1], Jean-Marc-Theler[1], Jean-Michel Gaspoz[1], Nicola Cantoreggi[2], Joël Chételat[3], Stéphane Joost[4] *on behalf of the GIRAPH group**

[1]Unit of Population Epidemiology, Geneva University Hospitals, Geneva, Switzerland. [2]Institut des sciences de l'environnement, University of Geneva, Geneva, Switzerland. [3]MicroGIS Foundation for Spatial Analysis, Switzerland [4]GIS Research Laboratory (LASIG), EPFL, Lausanne, Switzerland

**GIRAPH stands for* Geographic Information Research and Analysis in Public Health

INTRODUCTION

Urban health (UH) is an emerging field, which explores the effect of urban environment and urbanization on health. Evidence suggests that urban environment can either positively influence health behaviors or be a health stressor. One key approach in UH is the use georeferenced data and geographic information system (GIS). Mapping disease prevalence and trends provide insight into disease mechanisms and etiologies. An important limitation of GIS is that data sets have likely been collected separately by different agencies, often over different time periods. The Canton of Geneva deviates from this limitation as it has been collecting geographic and health-related information continuously since 1998 through the Unit of Population Epidemiology (UEP) of the Geneva University Hospitals and its Bus Santé study.

OBJECTIVE

Our aim was to measure the level of Body Mass Index (BMI) spatial dependence in the Canton of Geneva.

METHODS

We used data from the Bus Santé study. The Bus Santé study is an ongoing, community-based study designed to monitor chronic disease risk factors continuously in the Canton of Geneva, Switzerland. Each randomly selected participant receives several self-administered, standardized questionnaires covering the risk factors for the major lifestyle chronic diseases, sociodemographic characteristics, educational and occupational histories, as well as reproductive history for women. Participants' addresses are systematically abstracted, verified, and updated. Each participant undergoes a physical examination and blood collection in one of the three UEP clinic stations. Height and weight are measured using a standardized protocol. Body mass index (BMI) was calcuated as Weight [kg]/ Height [meter]^2. Spatial information collected (with the postal address as georeference) was used. We measured the level of spatial dependence of BMI. Spatial dependence means that we measured how similar were the different values of the different health variables under study for a set of randomly spatially distributed individuals (Bus santé data), and within a rigorously defined neighborhood. Measuring spatial autocorrelation permits a) to quantify the spatial regularity of a given phenomenon on a territory, and b) to determine the range of spatial dependence of this phenomenon on the same area.

The use of Local Indicators of Spatial Association (LISA) allow for the decomposition of global indicators into the contribution of each observation (an observation being any georeferenced individual participating to the Bus santé action). We used LISA a) as indicators of local pockets of nonstationarity (high/low risk "hot spots" for BMI), b) to assess the influence of individual or regional locations on the magnitude of the global statistic to identify outliers. We used two approaches: a) Correlation using the 40 closest neighbours, and b) Correlation using a threshold distance of 1000 meters.

RESULTS

Combining health-related data from the Bus Santé study and GIS, using LISA methods, the investigators detected significant spatial dependance with respect to BMI (Figure 1 and 2). The colored clusters represent significant spatial low-low BMI (blue color) and high-high BMI (red color) correlations. In the region where blue points are present, individuals with a BMI lower than average have neighbours who also show a BMI lower than the average; whereas where red points are present, individuals with a BMI higher than average have neighbours presenting a BMI higher than average.

These results clearly indicate that BMI levels are not distributed at random in the Canton of Geneva. There is a significant spatial dependance where points are shown either in red or blue. White dots express spatial neutrality (here, BMI values are randomly distributed). Performing preliminary exploratory analyses on blood pressure, investigators have identified cluster of individuals with higher blood pressure than the average, lifting up possible influences of environmental/urban factors (e.g., sidewalks, traffic, socioeconomic status).

CONCLUSIONS

This work has both public health and scientific importances. Indeed, this study presents a unique opportunity to determine spatial distribution of cardiovascular risk factors, such as BMI, and to further define the importance of the urban environment on health. Measuring the spatial dependence of chronic disease risk factors can further the understanding of risk distribution and can guide more effective strategies of housing and urban development (e.g., sidewalks, transportation), which could ultimately promote healthier behaviours.

Currently, little research has been conducted in Switzerland. The main reason is the difficulty to access to robust health data which have a valid link to location. In addition, geographic information on urban environment is generally sub-optimal. An ideal situation is encountered in the Canton of Geneva which collected more than 12-year of robust population health information, and has extensive public free information on urban environment. The GIRAPH group is aimed to further explore this area.

FIGURE 1

BMI: LISA closest neighbours; *40* closest neighbours

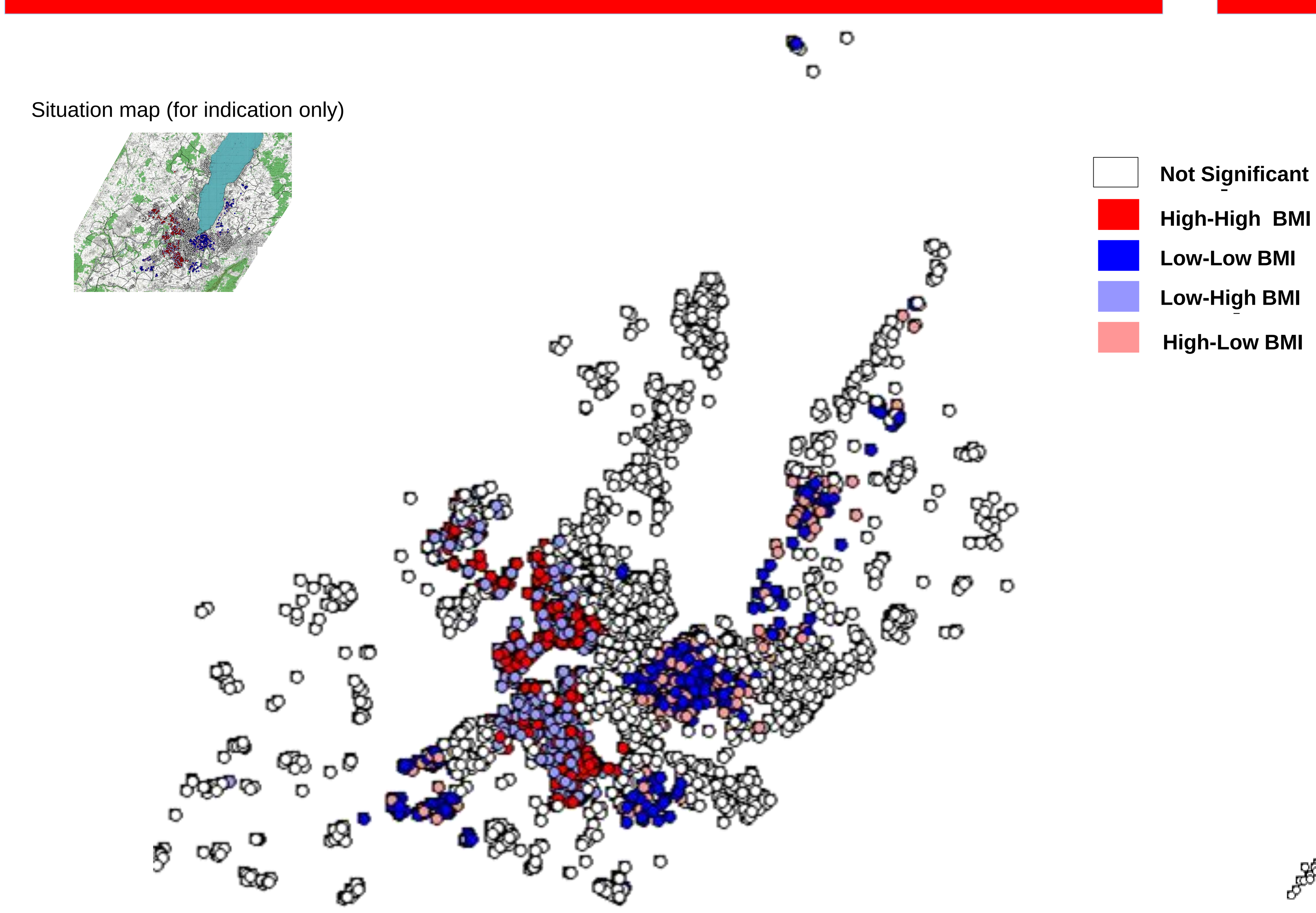
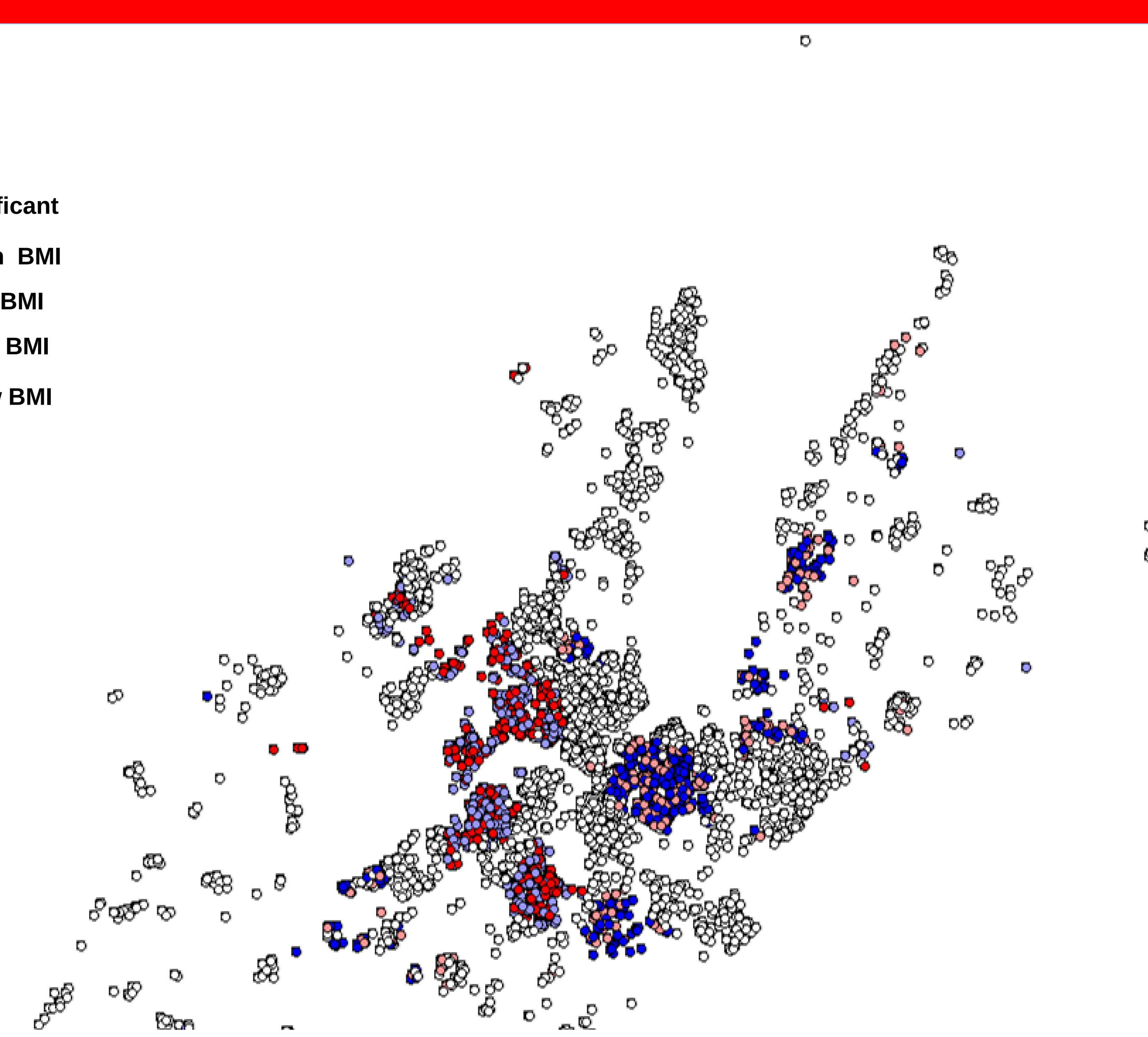


FIGURE 2

BMI: LISA threshold distance; *1000 meters*



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