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# The effect of human population density on health in Calgary, Canada

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## Introduction

### Background And Motivation:

- It has been found that there exists an inverse relationship between population density and health issues, driven in part by urban planning strategies.
- Sprawling, low density areas, with limited street connectivity and greater distances to key destinations give rise to individuals with increased health problems.
- An increase of one point on the sprawl index corresponded with an increase of 0.2% and 0.5% for risk of being overweight and obese, respectively (Lopez 2004).
- As density increased, rates of automobile use and body mass index were both found to decrease (Pendola and Gen 2007).
- Residents of a higher-density county had a less chance of having hypertension than residents of a low-density, sprawling county, by a factor of 0.94 (Ewing et al. 2003).
- Health should be taken into consideration when formulating municipal development approaches and, perhaps, dense development strategies should be implemented in sprawling cities such as Calgary.

### Objectives:

- Determine whether human population density in the City of Calgary has an impact on health, and if so, which health indicators may potentially be influenced by population density.
- Determine which areas of Calgary have higher incidences of health issues, using ALCES Online.



Figure 1. The City of Calgary (study area)

## Methods

### Datasets Used from Statistics Canada:

- December 2013 Health Profile: for information regarding obesity, asthma, arthritis, hypertension, chronic obstructive pulmonary disease (COPD), and cancer incidence, for 33 Canadian cities.
- 2011 Census: Population density, in units of people per square kilometer, for the 33 cities.

### Statistical Methods:

Linear regression was done to see if there exists a correlation between each health indicator and population density. Using ANOVA, it was then determined whether or not the relationships found were significant at the 95% confidence level ( $p < 0.05$ )

### Modeling Methods:

Based on the significant health indicators, and the health indicators found to be significant by other studies, simulations were done using ALCES Online. ALCES shows how different land use variables change in a specific area over time. The linear regression equations for significant indicators were plotted in the computer simulation model for Calgary. The model was set so that this equation was not applied to areas where people do not live.

## Results

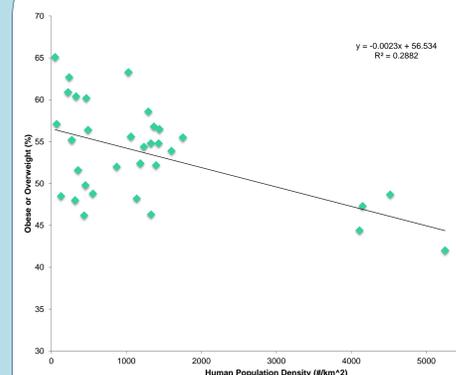


Figure 2. Linear relationship between population density and the percentage of the population that is either obese or overweight.

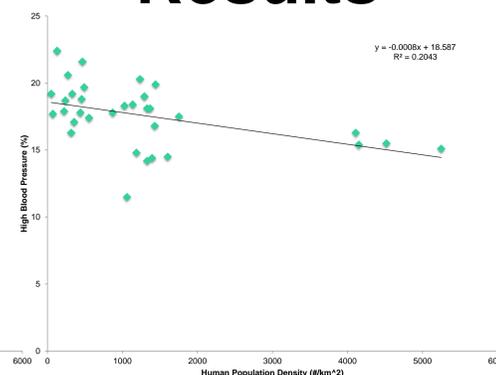


Figure 3. Linear relationship between population density and the percentage of the population that has hypertension (high blood pressure).

- Obesity (Fig. 2), hypertension (Fig. 3), COPD, and cancer incidence had significant inverse relationships with population density. Other studies also linked obesity and hypertension with population density, so these were further analyzed.
- The centre of Calgary and other dense areas had relatively lower incidences of obesity compared to peripheral areas and low density areas (Fig. 4). As the city is projected to sprawl outwards, this trend is expected to continue (Fig. 5).
- Suburbs of Calgary and surrounding towns were found to have increased incidences of hypertension (Fig. 6).

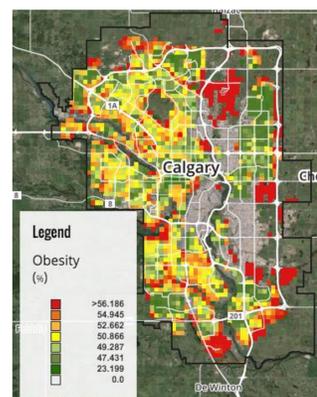


Figure 4. Obesity rates in Calgary, based on population density for the year 2010.

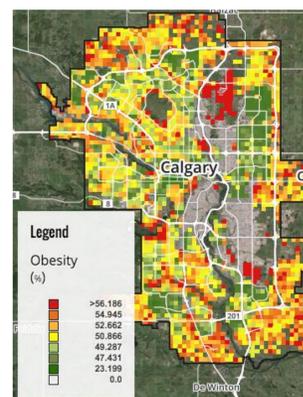


Figure 5. Obesity rates in Calgary, as expected for the year 2030, as Calgary sprawls outwards.

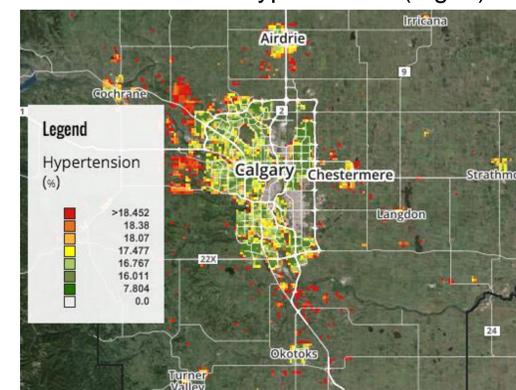


Figure 6. Hypertension rates in Calgary and the surrounding areas based on population density for the year 2010.

## Discussion

- It was found that there exists an inverse relationship between population density and obesity, hypertension, COPD, and cancer incidence.
- The main reason for this relationship is walkability. Areas that have greater street connectivity and mixed land use (both residential and commercial areas) generally have closer destinations, allowing individuals to walk, leading to an overall healthier lifestyle. Central and dense areas of cities usually embody these characteristics (Pendola and Gen 2007; Rundle et al. 2007).
- Most cities in Canada have decentralized and suburbanized over time (Behan et al. 2008).
- Smart growth strategies and compact city development must happen for sustainability, and the overall benefit of the population (Bunce 2004).
- Calgary can achieve a “smart growth” strategy by facilitating higher residential densities around LRT stations. This decreases reliance on automobiles, thus reducing adverse health consequences, all while having a more sustainable environment (Sun et al. 2007).

### Future Improvements

- As population density is not the only factor affecting health indicators, a multi-linear regression with multiple predictor variables may yield more accuracy

### Conclusion

Further studies of this type should be conducted to raise awareness of the negative impacts associated with sprawling municipal development plans. Such knowledge would be essential for the advocacy of dense development strategies for the betterment of the human population, while illustrating the necessity of a sustainable environment.

### Acknowledgements

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