Association of food outlet density and obesity: A cross-sectional study of urban areas in Mexico

Elisa Pineda, Jemima Stockton, Clare Llewellyn, Eric Brunner, Jennifer Mindell
Research Department of Epidemiology and Public Health, UCL

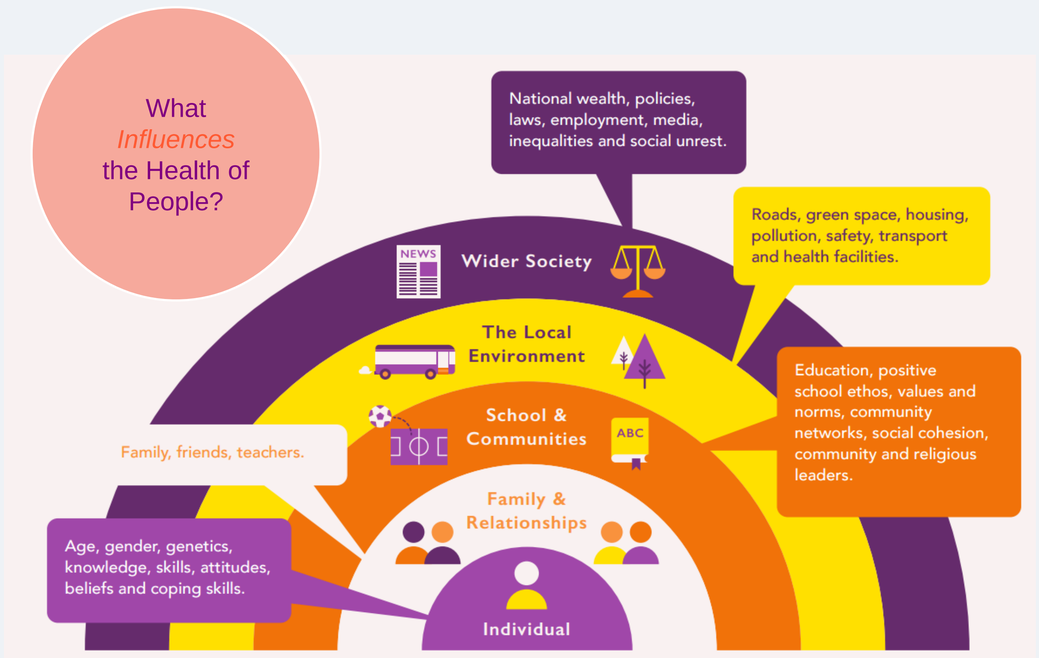
Objectives

1) To analyse the associations between total food outlet density and BMI;
2) To examine the association of the retail food environment index (RFEI) and obesity;
3) To study the association of the density of individual food outlets and obesity in Mexican adults in urban areas.

Background

Mexico has one of the highest obesity prevalence in the world: 70% of the population is overweight or obese. The country has gone through a dietary and food retail transition involving a switch from a healthy diet to a high-calorie-dense diet.

Figure 1. The food environment as a determinant of health



Methods

Data Sources are indicated in Table 1. I calculated densities of supermarkets, restaurants, chain and non-chain convenience stores, and fruit and vegetable stores in total and by individual food outlet type per 1,000 people per census tract area, using ArcGIS. I also calculated RFEI, the ratio of 'unhealthy' to 'healthy' food outlets. Using multilevel linear regression, I analysed the relationship between density of food outlet types and obesity using complex survey design in STATA14. All analyses were adjusted for sex, age, and socioeconomic status.

Table 1. Health and geographic data sources

Source	Year	Type of data
National health and nutrition survey (ENSANUT[a])	2012	Health
National statistic directory of economic units (DENUE), INEGI[b]	2014	Food outlets
Geo-statistic framework, INEGI[b]	2010	Geographic areas
Count and census of households and population, INEGI[b]	2010	Population

Figure 2. Geographic areas in Mexico

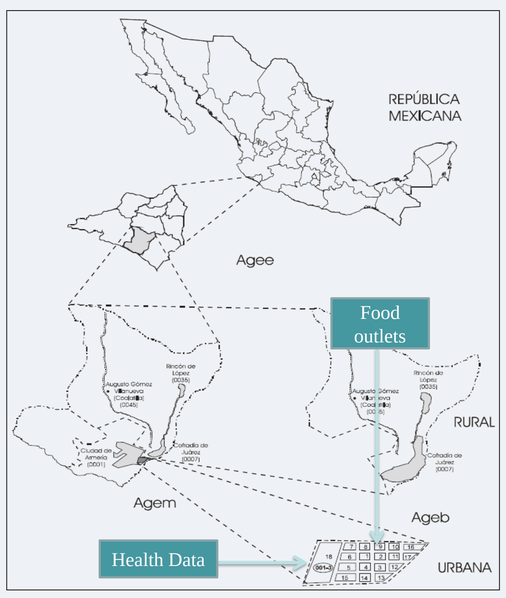


Figure 3. Geolocation health data and count of convenience stores

Results

Both non-chain convenience store density [β = 3.10, 95% CI: 0.97 - 5.23, *P* = 0.004] and total convenience store density (non-chain and chain combined) [β = 2.71, 95% CI: 0.63 - 4.80, *P* = 0.011] were significantly associated with obesity.
Total food outlet density showed no significant association with obesity. However, the RFEI was associated with higher levels of obesity [β = 0.040, 95% CI: 0.0005 - 0.020, *P* = 0.040].

Table 2. Relationship of RFEI and obesity

Model	β (CI)	P	Adjusted for
Model A	0.01 (0.0005, 0.02)	0.040	Age, sex and individual socioeconomic position
Model B	0.01 (-0.007, 0.03)	0.228	Model A + physical activity
Model C	0.01 (0.0004, 0.02)	0.043	Model B + car ownership, neighbourhood deprivation, food assistance programmes, health insurance, and household socioeconomic position, CTA (2nd level)
Model D	0.009 (-0.001, 0.02)	0.081	Deprivation, socioeconomic position, urbanicity of CTA
Model E	0.01 (0.0005, 0.03)	0.042	Age, gender, neighbourhood deprivation, food assistance programmes, health insurance, and household socioeconomic position.

RFEI: Retail food environment index. All results indicate coefficients (β) and confidence interval (CI) in parenthesis. β represents the increase of BMI in kg/m^2 per every unit increase of food outlet density.

Figure 2. Convenience stores in Mexico

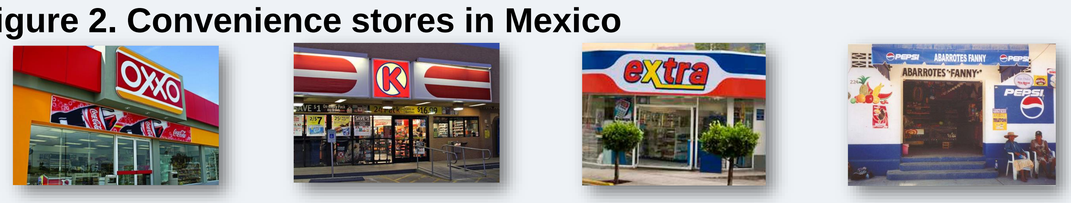
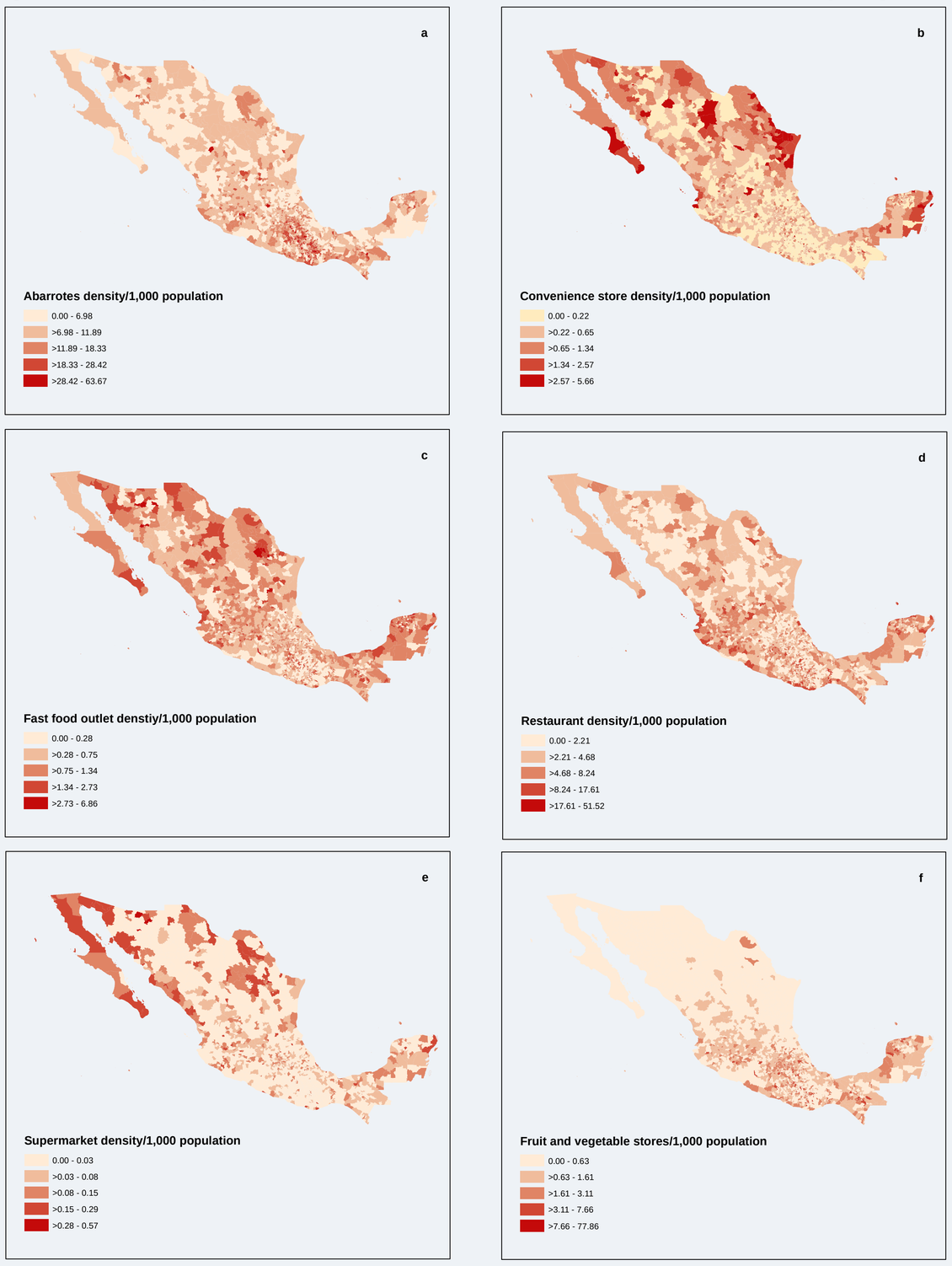


Table 3. Relationship of specific food outlet types and obesity

Variable	Model A	Model B	Model C	Model D	Model E
	β (CI)	β (CI)	β (CI)	β (CI)	β (CI)
Abarrotes	**3.10 (0.97, 5.23)***	1.50 (-2.68, 5.67)	1.56 (-0.80, 3.92)	**3.61 (1.37, 5.85)***	**3.07 (0.40, 5.74)***
Convenience stores	-15.84 (-32.30, 0.61)	-23.89 (-54.92, 7.14)	**19.11 (1.59, 36.63)***	-14.33 (-31.47, 2.82)	-12.12 (-35.73,11.48)
Abarrotes & Convenience stores	**2.72 (0.63, 4.80)**	1.04 (-3.05, 5.14)	1.86 (-0.48, 4.19)	**3.24 (1.04, 5.44)***	**2.95 (0.29, 5.61)***
Fast-food outlets	2.15 (-9.44, 13.75)	4.72 (-18.27, 27.71)	12.25 (-1.24, 25.73)	3.13 (-9.13, 15.40)	7.45 (-8.01, 22.91)
Restaurants	0.07 (-2.50, 2.64)	-2.45 (-7.76,2.86)	-0.73 (-3.72, 2.27)	-0.47 (-2.25, 3.19)	-1.38 (-5.13, 2.36)
Supermarkets	-35.40 (-96.90, 26.09)	-22.71 (-141.3, 95.84)	-27.23 (-99.24, 44.76)	-27.65 (-91.17, 35.87)	-53.00 (-133.4, 27.37)
Fruit & vegetable stores	0.42 (-2.74, 3.59)	-0.32 (-8.86, 8.22)	-0.13 (-3.72, 3.46)	0.90 (-2.36, 4.17)	1.64 (-3.22, 6.50)

Abarrotes: Non-chain convenience stores. All results indicate coefficients (β) and confidence interval (CI) in parenthesis. β represents the increase of BMI in kg/m^2 per every unit increase of food outlet density. **Model A:** Age, sex and individual socioeconomic position. **Model B:** Model A + physical activity. **Model C:** Model B + car ownership, neighbourhood deprivation, food assistance programmes, health insurance, and household socioeconomic position, CTA (2nd level). **Model D:** Deprivation, socioeconomic position, urbanicity of CTA. **Model E:** Age, gender, neighbourhood deprivation, food assistance programmes, health insurance, and household socioeconomic position.

Figure 4. Density of food outlets in cities of Mexico per 1,000 people



City level density of: a) non-chain convenience stores [abarrotes], b) convenience stores, c) fast food outlets, d) restaurants, e) supermarkets and f) fruit & vegetable stores.

Conclusion

Convenience stores, which offer a greater availability of energy-dense foods with low nutrient content, pose a risk for higher levels of obesity. A better balance of healthier food outlets to non-healthy food outlets could decrease the risk of obesity in urban areas of Mexico.

References
[a] ENSANUT – National Health and Nutrition Survey in Mexico, 2012.
[b] INEGI – National Institute of Statistics and Geography in Mexico, 2010 and 2014.

Contact details
Twitter: @elisap_ana
Email: elisa.pineda.14@ucl.ac.uk