

Determinants of individual obesity risk in Spain:A multi-level model combined with a spatial analysis

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Outline

- 1 Motivation
- 2 Background to the reasearch
 - SES and obesity
 - Obesogenic Environments
- 3 Objectives
- 4 Contribution
- 5 Why is Spain an interesting case?
 - Spatial Analysis-Mapping
- 6 The model
- 7 Results
- 8 Conclusions
- 9 Discussion-Extensions

Motivation

- Obesity is one of the most serious public health challenges of the 21st century.
- The proportion of overweight and obese adults has substantially increased (OECD, 2014).
- Obesity is a risk factor for major chronic diseases (high blood pressure, type II diabetes, many types of cancer).
- Understanding the causes of obesity allows for policy intervention and is crucial for policy evaluation.

SES and obesity

Research has established a strong correlation between SES and weight status

- Sobal and Stunkard (1989): clear-cut evidence of association between socio-economic position and obesity
- Drewnowski (2003): wealth and poverty have profound effects on diet structure, nutrition and health
- Drewnowski and Specter (2004): population groups with the highest poverty rates and low education exhibit the highest obesity rates
- Monteiro et al (2004): obesity is increasing faster in low-SES sub-populations

Obesogenic Environments

There is a growing consensus that certain environments tend to encourage obesity more than others (Egger and Swinburn 1997).

- Bailey and Gatrell (1995): prevalence of overweight and obesity in one region are likely to be correlated with prevalence in nearby regions
- Freudenberg et al (2005): rapid suburbanization is associated with rising obesity and decreased physical activity
- Costa-I-Font and Pons-Novell (2007): while observing health outcomes, it is crucial to control for potential spatial dependency

Objectives

- 1 Perform a spatial autocorrelation analysis and check for any spatially persistent areas of high obesity rates
- 2 Control for socioeconomic heterogeneity related to obesity spatial clustering across the area under investigation
- 3 Observe how personal as well as contextual factors influence individual weight status and obesity

Contribution

Investigate the determinants of individual weight status and obesity considering not only personal characteristics, but also:

- features related to the individual's approximate environment
- features corresponding to the wider contextual setting to which both people and their approximate environments belong

Why is Spain an interesting case?

- Obesity rates in Spain are relatively high compared to the OECD (Spain 24,6% - OECD average 23%)
- Large social inequalities
- Decentralized structure of the country

Distribution of weight status and income across Spanish provinces



Figure : Distribution of BMI

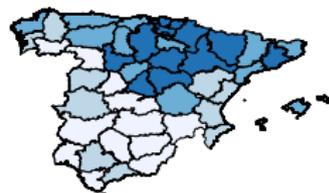


Figure : Income Distribution

The model (1)

Hypothesis:

- ① individuals interact within their social contexts and therefore they are influenced by the social groups where they belong
 - ② individual health outcomes are not simply influenced by people's proximate environment (census section), but also their broader region (autonomous communities)
- Data
National Health Survey of Spain for 2011-2012 (INE)
representative sample of 21,007 adults over 52 Provinces of Spain

The model (2)

Specification 1: linear 3-level mixed effects model (BMI)

Specification 2: logistic 3-level mixed effects model (Obesity)

- *The Random Intercept Model :*

$$Y_{i,j,k} = \alpha + \beta X_{ijk} + \theta_j + \mu_k + e_{ijk}$$

- *The Random Coefficient Model :*

$$Y_{i,j,k} = \alpha + \beta X_{ijk} + \gamma_k X_{ijk} + \theta_j + \mu_k + e_{ijk}$$

Results (1)

Table : Results of Analysis-Multilevel Linear Model

<i>Dependent Variable</i>	Specification 1 BMI		
	OLS	Random Intercept	Random Coefficient
Fixed Part			
Personal Characteristics			
intercept	23.58(.37)**	21.88(.56)**	22.08(.56)**
female	-.36(.07)**		-.35 (.09)**
age	.11(.012)**	.10 (.012)**	.10 (.012)**
age2	-.09(.01)**	-.08(.01)**	-.08(.01)**
marital status (single)			
<i>married</i>	1.57(.09)**	1.53(.10)**	1.53(.10)**
<i>widowed</i>	1.70(.14)**	1.63(0.22)**	1.63(0.22)**
<i>separated/divorced</i>	.86(.016)**	0.74(0.21)	0.74(0.21)
native	-.09(.03)**	-.07 (0.033)**	-.07 (0.033)*
education (low)			
<i>moderate</i>	-.63(.10)**	-.62 (.10)**	-.62 (.10)**
<i>high</i>	-1.15(.13)**	-1.18 (.14)**	-1.18 (.14)**
social class (low)			
<i>upper</i>	-1.20(.12)**	-1.22 (.125)**	-1.22 (.125)**
<i>middle</i>	-.70(.09)**	-.69 (.09)**	-.69 (.09)**
unemployment	.37(.09)*	.32(.12)*	.32(.12)*
smoke	-.83(.09)**	-.83(.10)**	-.83(.10)**
drink	-.04(.015)*	-.054 (.026)*	-.054 (.026)*
physical activity	-.09(.01)**	-.07(.02)**	-.08(.03)**

Results (2)

Table : Results of Analysis-Multilevel Linear Model

Dependent Variable	Specification 1 BMI		
	OLS	Random Intercept	Random Coefficient
Regional Characteristics			
urban	-.23(.07)*	-.21 (0.9)*	-.21 (0.9)*
poverty risk	.03(.005)**	.03 (.006)**	.03 (.006)**
income	-.011(.001)*	-.045 (.02)*	-.045 (.02)*
Interaction effect			
women*crime	-	.15(.03)**	
Random Part			
σ^2_{ϵ}		4.1	4.01
σ^2_{μ}		.84	.93
σ^2_{γ}		.74	.89
σ^2_{δ}			.63
σ^2_{λ}			.59
ICC		7.1%	9.3%

Note: Standard errors are in parenthesis, control groups are in parenthesis, *: $p < .01$,

**: $p < .005$

Results (3)

Table : Results of Analysis-Multilevel Logistic Model

<i>Dependent Variable</i>	Specification 2 Obese	
	Logit Model	Random Intercept Model
Fixed Part		
Personal Characteristics		
intercept	.08(.02)**	.03(.07)**
female	.98(.05)	.07(.06)
age	1.05(.08)**	1.05(.09)**
age2	.99(.000)**	.99(.000)**
marital status (single)		
<i>married</i>	1.62(.09)**	1.62(.10)**
<i>widowed</i>	1.70(.14)**	1.69(.14)**
<i>separated/divorced</i>	1.05(.11)	1.03(.12)
native	.095(.02)*	.095(.03)*
education (low)		
<i>moderate</i>	.79(.04)**	.79(.04)**
<i>high</i>	.66(.05)**	.67(.06)**
social class (low)		
<i>upper</i>	.56(.04)**	.55(.05)**
<i>middle</i>	.66(.03)**	.67(.04)**
unemployment	.99(.07)	.98(.074)
smoke	1.07(.13)**	1.07(.13)**
drink	1.01(.09)*	1.01(.10)*
physical activity	.95(.01)**	.95(.01)**

Results (4)

Table : Results of Analysis-Multilevel Logistic Model

<i>Dependent Variable</i>	Specification 2	
	Logit Model	Random Intercept Model
Regional Characteristics		
urban	.97(.05)*	.85(.08)
poverty risk	1.01(.003)**	1.01(.013)*
income	.99(.003)**	.99(.003)**
Interaction effect		
women*crime		1.09(.002)*
Random Part		
ICC		9.01%

*Note: Standard errors are in parenthesis, control groups are in parenthesis, *: $p < .01$,*

***: $p < .005$*

Conclusions

- Approximately 9.3% of the total variance in BMI is represented at the regional level
- Crossed Level Interaction: Criminality has a significant effect only for women
- The Postestimation LR test suggests that the Random Coefficient Model fits better only for the first specification
- Obtained a more accurate representation of the effect of the covariates on BMI and Obesity:
 - ① The standard errors increase compared to the OLS model
 - ② The slope of some of the covariates on BMI and obesity slightly drops

Discussion-Extensions

- Relationships vary between clusters.
- Local governments and communities can play an important role in developing environments that encourage and support active living.
- Extend the analysis by:
 - ① including to the model specific variables capturing the existence of local-specific interventions.
 - ② consider substantial number of lags

Thank you for your attention!

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