Spatial Transition of Obesity Epidemic in Taiwan from 2001-2005: A Spatial Multilevel Approach

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Problem with obesity

- **Major worldwide health problem.**

  - The wide-ranging health effects of obesity, including increased risk of type-2 diabetes, cardiovascular disease, and various cancers

- **Well-defined social determinants of obesity**

  - Individual Characteristics

    - Such as, education, gender, age, diet, life-style, and socioeconomic status …

Social Epidemiology of Obesity
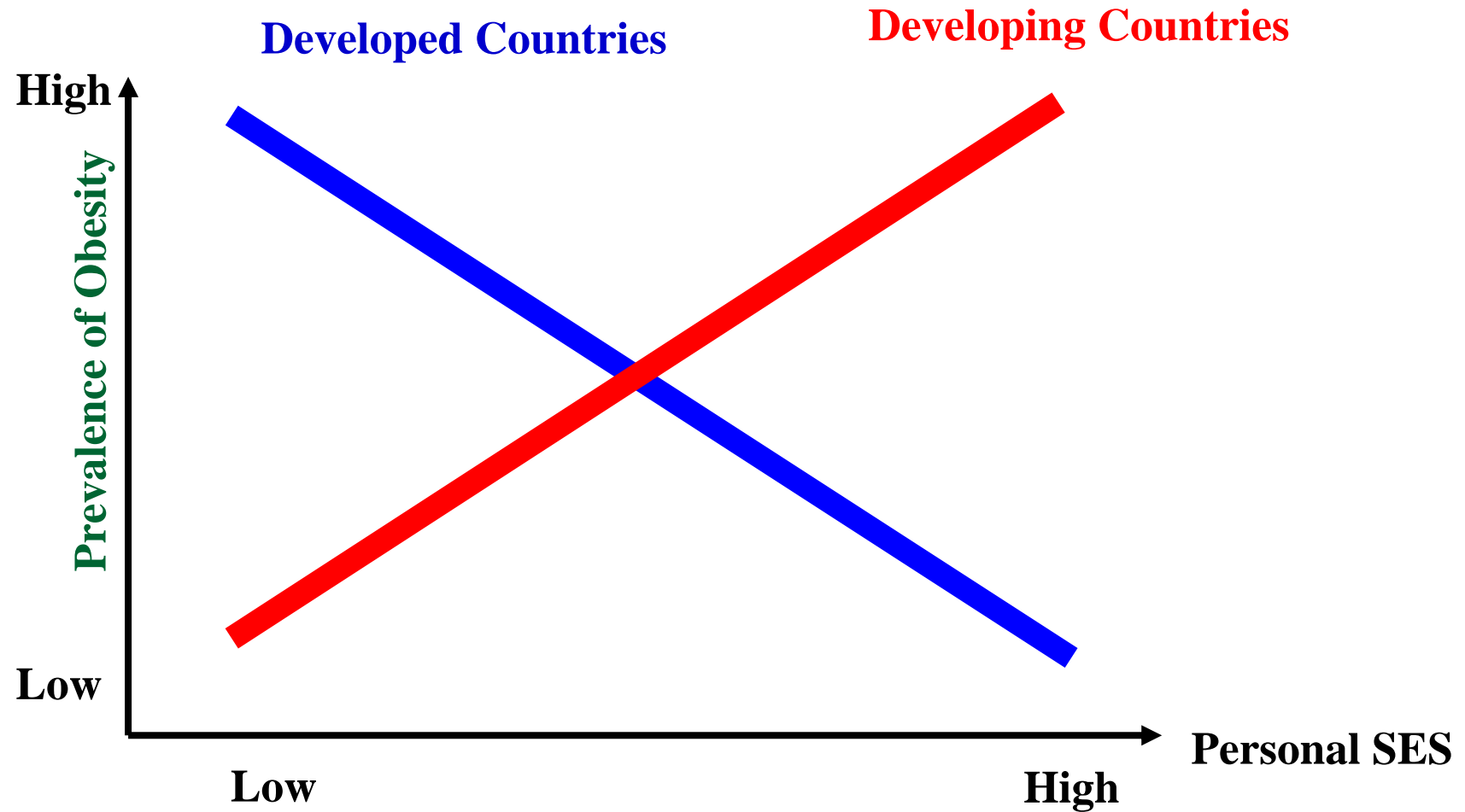
What Causes Obesity Epidemics

Social Determinates

Health Outcome: Obesity

Social-Behavioral Components：
Individual Characteristics
(such as, education, diet, life-style,
socioeconomic status…)

*Individual
Behavior*
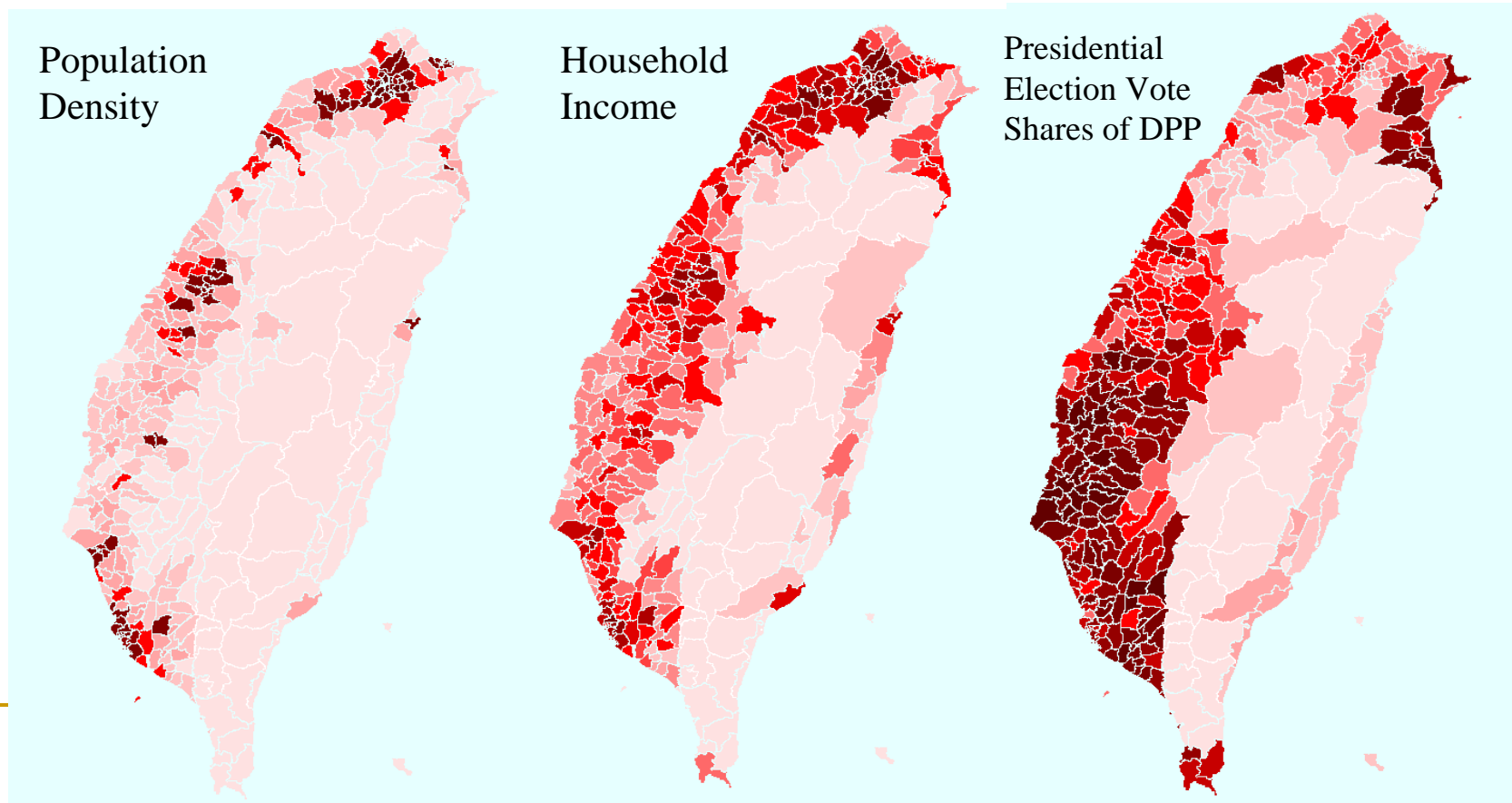
Contextual Effects：
"Obesogenic" (obesity promoting) Neighborhood
(Concentrated disadvantaged areas or
High-income clusters…)

Rationale

- ## contextual effects *DO* exist in human society.

  - ❏ By measuring spatial dependency

Population Density

Household Income

Presidential Election Vote Shares of DPP

Research Aim

- ***AIM***: Identifying the effects of area-level context on obesity in Taiwan from 2001-2005.

- Why we are interested in **contextual effects**?

  - ❑ Identifying specific "**obesogenic**" (obesity promoting) "<u>AREAS</u>".

  - ❑ Spatial targeting of health interventions

Changing Environments → **Changing Population Health**
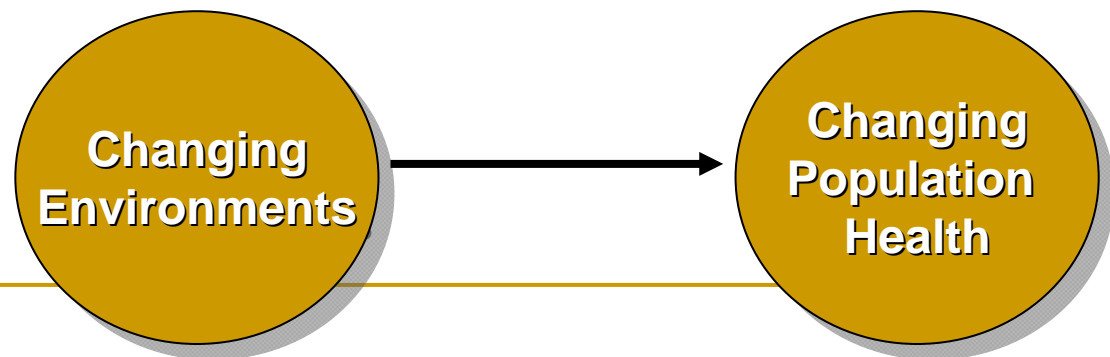
Data Source

- **2001, 2005 Social Development Survey on Health and Safety (SHDSH)**
  - ❑ **A representative sample**

Data Source

- **We have a total of …**
  - 27,593 (2001); 25,985 (2005) adults aged 20-64 yrs. Students, people sick for a long time were excluded.
  - Within 262 townships(2001); 266 townships(2005)
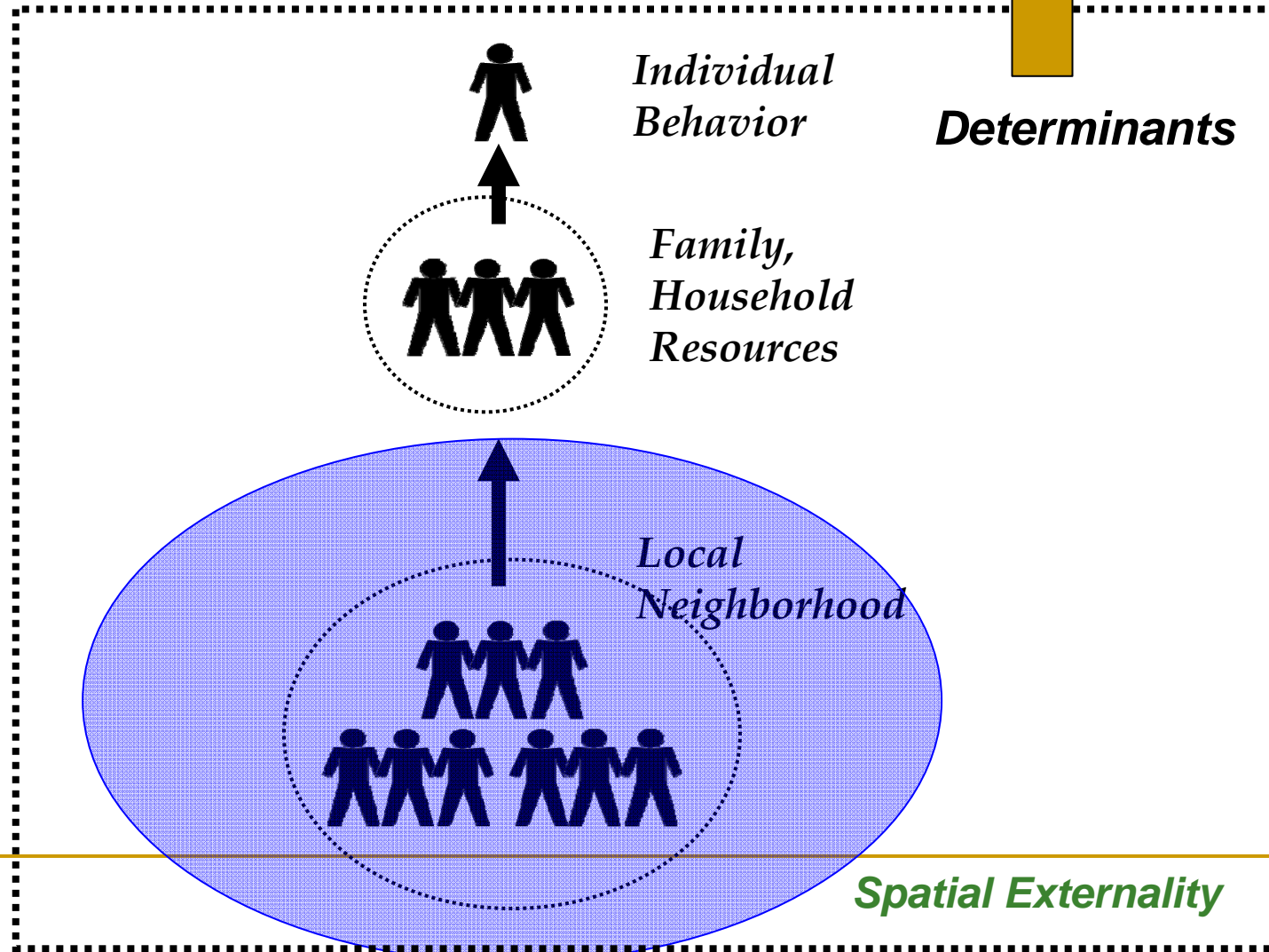 - No significant differences between two samples.

Method: Multilevel Analysis

Health Outcome:
Individual Obesity

Individual
Behavior

Determinants

Family,
Household
Resources

Local
Neighborhood

Spatial Externality

Methods

Multilevel Modeling

Spatial Autocorrelation Model

Level 2: Neighborhood Variables (Socioeconomic Clusters)

High-income non-aboriginal clusters
Low-income non-aboriginal clusters
Low-income aboriginal clusters
Not low-income aboriginal clusters

(adjusted)   *(unadjusted)*
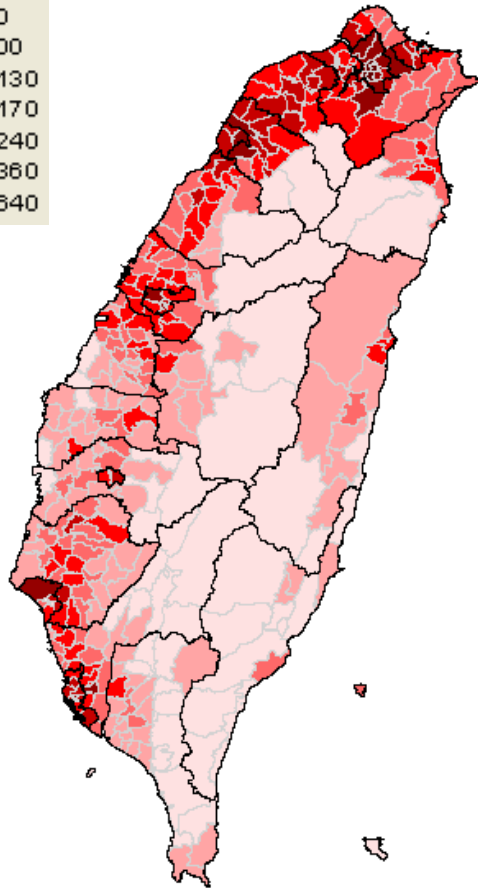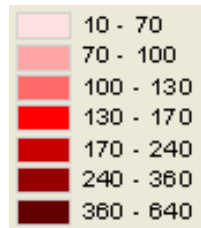
Level 1: Individual Variables

Socioeconomic position

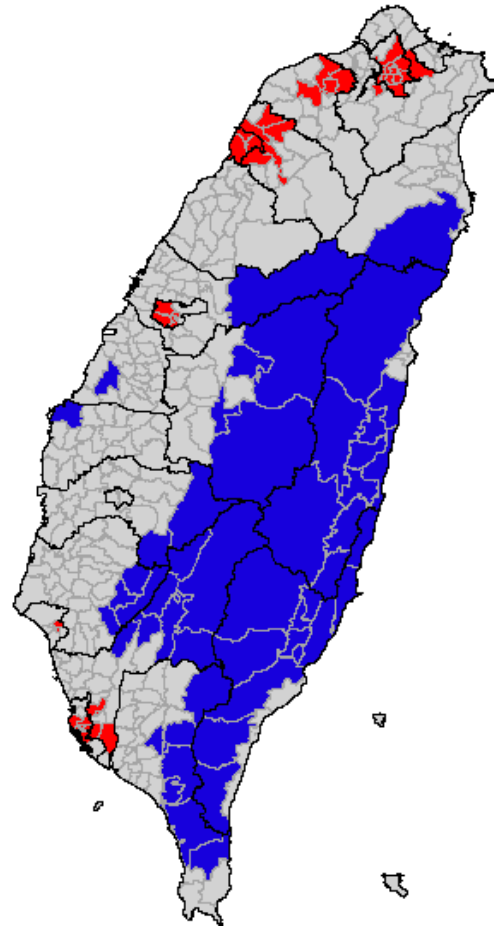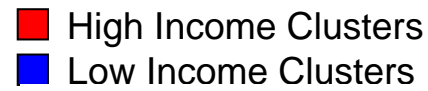$$\text{BMI} = \frac{\text{weight (kg)}}{\text{height}^2 (\text{m}^2)}$$

Dependent Variable: Personal Health Outcome (BMI)

Results of Spatial Autocorrelation Model

Household Income
In 2005

	10 - 70
	70 - 100
	100 - 130
	130 - 170
	170 - 240
	240 - 360
	360 - 640

Socioeconomic Clusters

High Income Clusters
Low Income Clusters

Aboriginal Areas

□ **Non-aboriginal township**
■ **Aboriginal township**
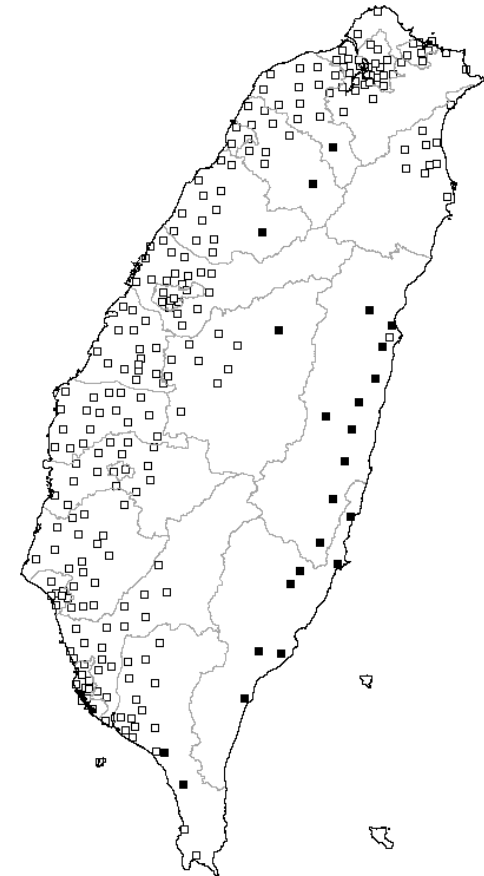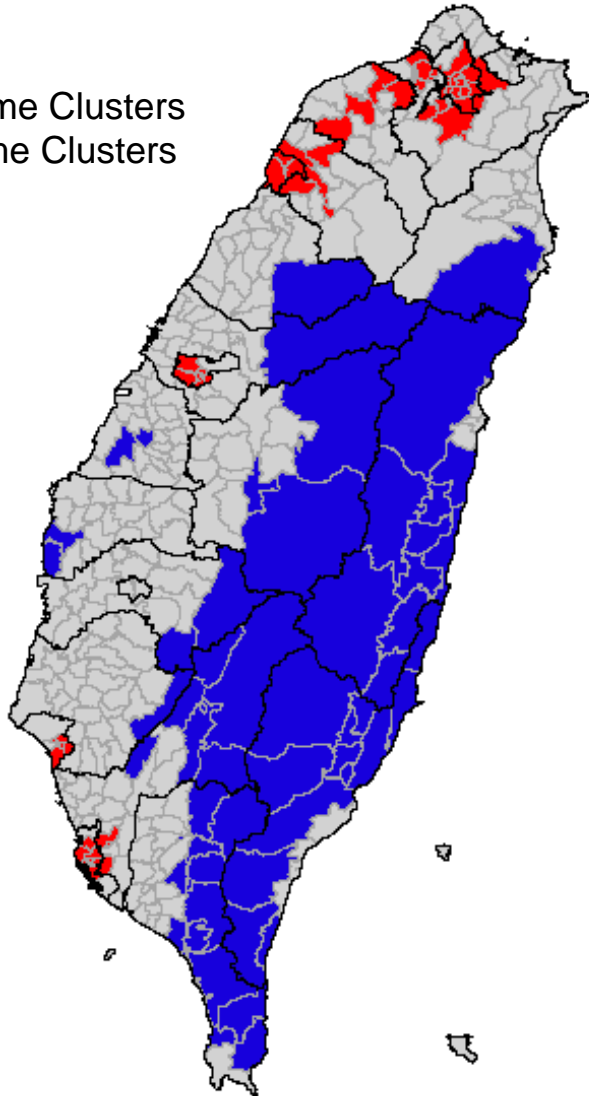
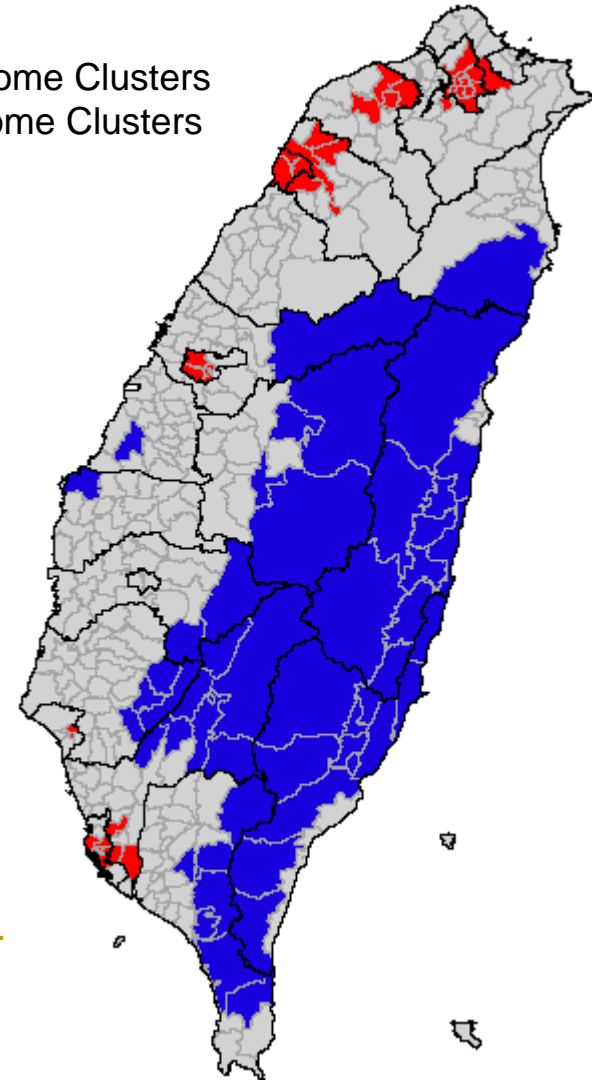# **Results:** Spatial Patterns of Area-based Socioeconomic Status, 2001-2005

-2001-

🟥 High Income Clusters
🟦 Low Income Clusters

-2005-

🟥 High Income Clusters
🟦 Low Income Clusters

Results of Multilevel Analysis

	Year 2001				Year 2005			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	β	SE	β	SE	β	SE	β	SE
Intercepts (G00)	22.896	0.044	17.625	0.352	23.639	0.040	20.360	0.352
Neighborhood-level variables (level 2)								
Socioeconomic Clusters [not high-high or low-low income clusters]								
High-income non-aboriginal clusters	0.104#	0.061	0.078	0.075	-0.177	0.093	0.035	0.095
Low-income non-aboriginal clusters	**0.290****	0.345	0.052	0.155	**0.463****	0.173	**0.254#**	0.172
Low-income aboriginal clusters	**0.619***	0.132	0.483	0.342	**1.425****	0.362	**1.222****	0.305
Not low-income aboriginal clusters	**0.553****	0.152	**0.393****	0.150	**0.582***	0.254	**0.452***	0.201

Year 2001:
The effects of MOST SES clusters on BMI can be explained by individual factors
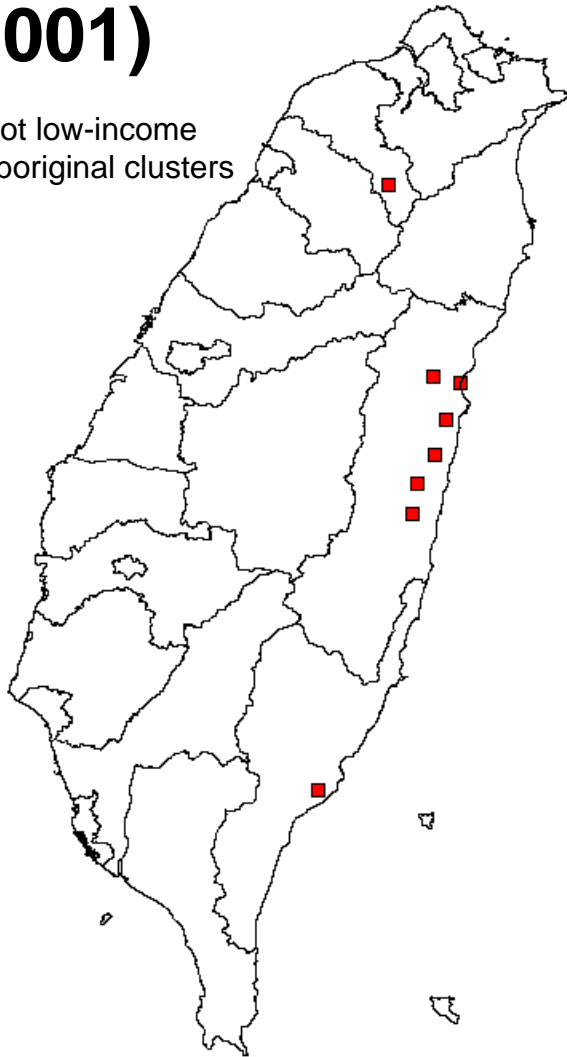
Year 2005:
The effects of SES clusters can NOT be explained by individual factors

Where are those significant SES clusters from 2001-2005?

(2001)

- ■ Not low-income aboriginal clusters
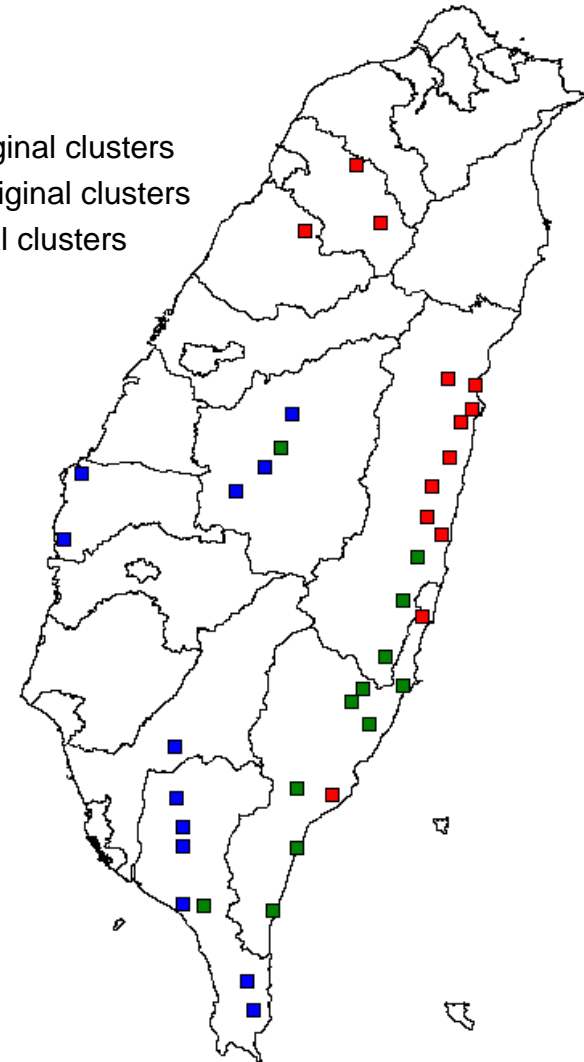
(2005)

- ■ Not low-income aboriginal clusters
- ■ Low-income non-aboriginal clusters
- ■ Low-income aboriginal clusters

Spatial Transition

Spatial Spillover Effects of Obesity
(due to neighborhood interactions)

Dependent Variable:
Personal Health
Outcome (BMI)

$$BMI = \frac{weight\ (kg)}{height^2 (m^2)}$$

Individual Variables

Socioeconomic
position

Area-based Variables

Multilevel Neighborhood-specific Residuals

Spatial Lagged
Effects ?
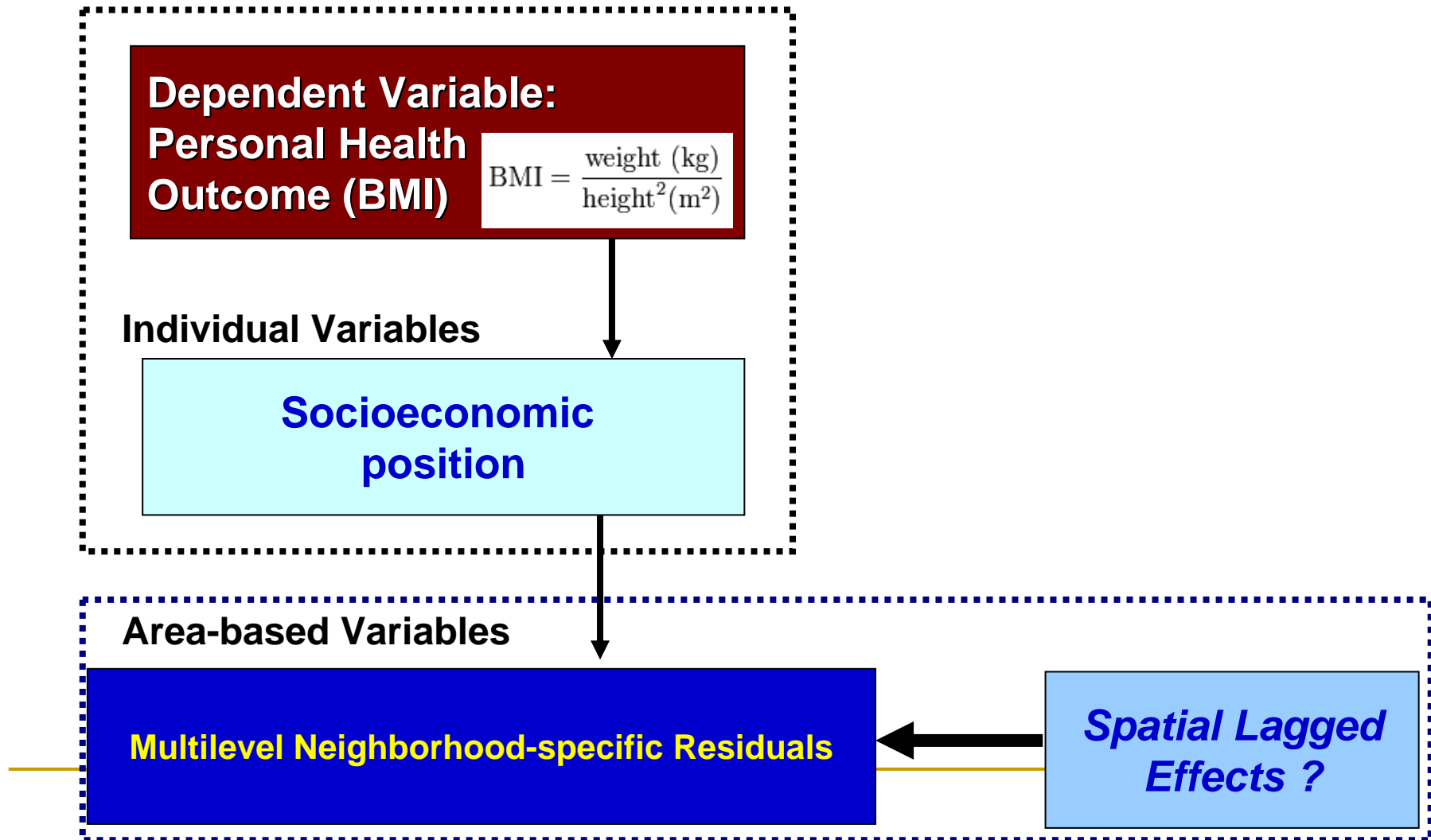
Spatial Lag Model

- $Y = X\beta + \rho \, W\mathbf{y} + \varepsilon$

  W: spatial weight matrix

  - Y: Model Residuals
  - X: Aboriginal Area (binary)

- Spatial Lagged Effects

  - If ρ is statistically significant, it implies that the neighbors of **Y DO** affect the value of **Y.**

  - ***Evidence of Global Contextual Effects***

Result of Adjusted-ecological Approach (after controlling individual variations)

	Year 2001			Year 2005		
	Coefficient	Asymptot t-stat	z-probability	Coefficient	Asymptot t-stat	z-probability
Constant	-0.008	-0.676	0.499	-0.046	-1.781	0.074
Aboriginal Township	0.097	2.342	0.019*	0.508	5.368	0.00*
Spatial lag (rho)	0.031	0.302	0.762	0.167	1.825	0.06#

#P<0.1, *P<0.05, **p<0.01

Contextual Effects

Conclusion

- **Area-based inequality of health risk.**

- **Identifying specific "*obesogenic*" (obesity promoting) "*AREAS*".**

- **Individual neighborhoods are embedded in large socioeconomic clusters.**

- **Spill-over effect for area-based obesity risk**

- **Proposing an adjusted-ecological approach for spatial dependence.**