AREA-BASED VARIATIONS IN CERVICAL CANCER PREVENTION: RESULTS OF A SPATIAL ANALYSIS IN COLOMBIA

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Outline

• Introduction
  o Colombia in context
  o Primary and secondary prevention
  o Objectives

• Methodology

• Results

• Implications of the results
Colombia in context

• One of the most inequitable countries in Latin America¹,²,³
  o High levels of poverty
  o Differences by regions

• Barriers to access health services among⁴:
  o Socially disadvantaged populations
  o Individuals with different health insurance programs

• Internal armed conflict
  o High economic and social impact⁵
  o Forced internal displacement of individuals to big cities⁶
    ▪ Women and children
    ▪ Health status of displaced populations
    ▪ Access to health care

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Colombia in context

- Cervical cancer (CC)
  - Second cause of cancer mortality among women in the country\(^1\)
  - Estimated burden of pre-cervical cancers\(^2\):
    - 8 million international dollars (2005)
  - Included as a national priority\(^3\)

- No studies describing the spatial variations of limited access to primary and secondary CC prevention programs have been conducted

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Primary and secondary prevention

• Primary prevention¹
  o Prevent disease occurrence among susceptible individuals
    ▪ Disease education, vaccination, health promotion, etc.

• Secondary prevention¹
  o Reduce the burden of disease by identifying asymptomatic individuals with the disease in an early stage
    ▪ Screening

• Both strategies are important to prevent CC²

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Objectives

To use global and local tests for clustering to describe spatial patterns in the frequency of not having heard of HPV vaccination and not having had a Pap test.
METHODOLOGY
Methodology

• Population of study
  - Colombian girls and women (13-49 years) who have not heard of HPV vaccination
  - Colombian women (18-49 years) who have never had a Pap testing

• Data
  - 2010 Colombian National and Demographic Health Survey
  - 2010 estimations of population by the Colombian National Department of Statistics

• Dependent variables

<table>
<thead>
<tr>
<th>Having not heard of HPV vaccination</th>
<th>Having not had a Pap test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of women who have not heard of HPV vaccination at the department level</td>
<td>Frequency of women who have not had Pap testing at the department level</td>
</tr>
</tbody>
</table>
Methodology

• Statistical analysis
  o Global and local cluster identification
    ▪ Moran’s I test (*R* software)
    ▪ Kulldorff’s spatial scan statistic (*SaTScan* software)
  o Bayesian Poisson models with random effects
    ▪ Account for spatially structured and unstructured variability (*WinBugs*)

• Models

<table>
<thead>
<tr>
<th></th>
<th>MODEL 1</th>
<th>MODEL 2</th>
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<tbody>
<tr>
<td>DV:</td>
<td>having not heard of HPV vaccination</td>
<td>having not had a Pap test</td>
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<tr>
<td>• Departmental frequency of women with no formal education, subsidized health insurance, and living in rural areas</td>
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<td>• 2010 population density</td>
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</table>

• Results were mapped in *ArcGIS*
RESULTS
Results

- Women who have not heard of HPV vaccination
  - In total, 39,158 (73.2%)

- Women who have not had Pap testing
  - In total, 5,128 (12.7%)

- Significant spatial autocorrelation in both variables of study
  - Moran’s I HPV vaccination=0.49, p-value=0.0003
  - Moran’s I Pap testing=0.34, p-value=0.0004

- Three statistically significant local clusters of cases were found for each of the dependent variables
Results

Legend
- Having not heard of HPV vaccination
  - Local spatial clustering
  - Cluster 1: Relative risk 1.49
  - Cluster 2: Relative risk 1.13
  - Cluster 3: Relative risk 1.07
  - No clustering

Legend
- Having not had Pap testing
  - Local spatial clustering
  - Cluster 1: Relative risk 2.25
  - Cluster 2: Relative risk 1.36
  - Cluster 3: Relative risk 1.40
  - No clustering
Results

• Model 1

$$\ln(y) = \ln(e_i) + \alpha + \beta_1 X_{\text{NoEdu\_propCAT}} + \beta_2 X_{\text{rural}} + \beta_3 X_{\text{Subs\_ins}} + \beta_4 X_{\text{NoEdu\_propCAT \times rural}} + \nu_i + \mu_i$$

where:
- $X_{\text{NoEdu\_propCAT}}$ represents the categorised proportion of no education in each department;
- $X_{\text{rural}}$ represents the proportion of women living in rural areas in each department;
- $X_{\text{Subs\_ins}}$ is the proportion of women with subsidised health insurance by departments,
- $X_{\text{NoEdu\_propCAT \times rural}}$ represents the interaction term between the categorised proportion of no education and the proportion of rurality in each department.

$\mu$ is the structured variability
$\nu$ is the unstructured variability

• Model 2

$$\ln(y) = \ln(e_i) + \alpha + \beta_1 X_{\text{Subs\_ins}} + \beta_2 X_{\text{Density\_CAT}} + \nu_i + \mu_i$$

where:
- $X_{\text{Subs\_ins}}$ is the proportion of women with subsidised health insurance by departments, and
- $X_{\text{Density\_CAT}}$ represents the categorised proportion of population density in each department.

$\mu$ is the structured variability
$\nu$ is the unstructured variability

• Both models recognized that these spatial variations were associated with the departmental percentage of women with subsidized health insurance.

• These models identified that HPV vaccine awareness and Pap testing were less common in peripheral Colombian departments.
Results

Having not heard about HPV vaccination

Having not had Pat testing
POPULATION HEALTH IMPLICATIONS
Population Health Implications

• This study applies a methodology useful to:
  o Demonstrate spatial variations in health outcomes to different stakeholders in Colombia
  o Target specific CC prevention programs in high-risk departments
  o Understand departmental socioeconomic factors associated with the uptake of primary and secondary CC prevention strategies

• Spatial analyses are useful to study patterns of health-related outcomes considering:
  o Behavior of the outcome in neighboring areas
  o Inclusion of explanatory variables (e.g. area-based socio-demographic factors)

• This methodology could be successfully replicated in other settings.
Population Health Implications

- There are departments in Colombia with a higher risk of not having heard of HPV vaccination and not having had Pap testing
  - Chocó
  - Vichada
  - Guanía
  - Guaviare
  - Vaupés
  - Amazonas

- Need to focus resources towards more disadvantaged and high-risk areas
Acknowledgements

- PROFAMILIA, Colombia

- National Administrative Department of Statistics, Colombia

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- Western Regional Training Centre for Health Services Research

- School of Public Health, University of Saskatchewan
THANK YOU!
Residual variation for not having heard of HPV vaccination
Residual variation for not having heard of HPV vaccination
Diagnostics of Bayesian analysis

- Informally:
  - Brook-Gelman-Rubin
  - Autocorrelation plots

- Formally
  - Gelman and Rubin
  - Geweke
  - Raftery-Lewis
  - Heidelberger-Welch
    - Chains reached stationarity for each of the variables in the model ($p$-values > 0.05)

<table>
<thead>
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<th>Burn-in (M)</th>
<th>Total (N)</th>
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