Discovering Hidden Patterns in County-Level Diagnosed Diabetes Prevalence in The United States Using Neural Networks: A Spatio-Temporal Analysis From 2011 to 2020

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Disclaimer

The findings and conclusions in this presentation are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention

Outline

- Introduction
- Spatio-Temporal Analysis: A Machine Learning Approach
- Results
- Discussion

Introduction

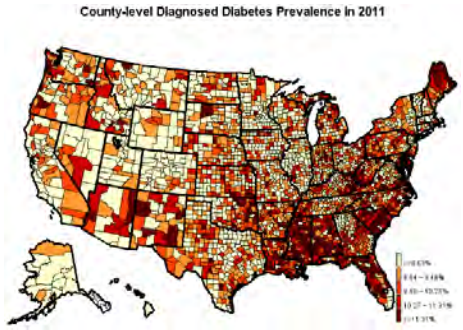
- Despite a slowdown in national diabetes prevalence over the past decade in the United States, trends in the prevalence of diagnosed diabetes are highly variable at lower geographic levels.

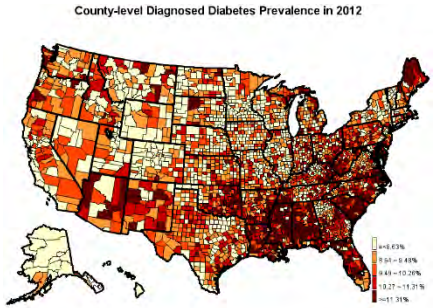
- This study aims to unveil intricate patterns and relationships in diabetes prevalence at the county level.

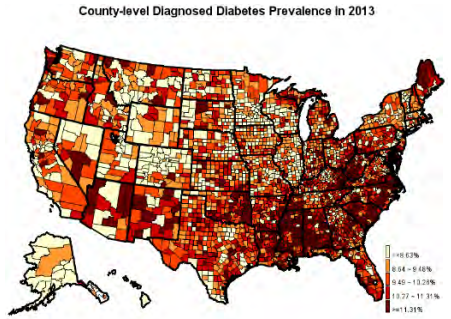
- We applied small area estimation (SAE) techniques to estimate county-level diagnosed diabetes incidence rates, using data sourced from the Behavioral Risk Factor Surveillance System (BRFSS).

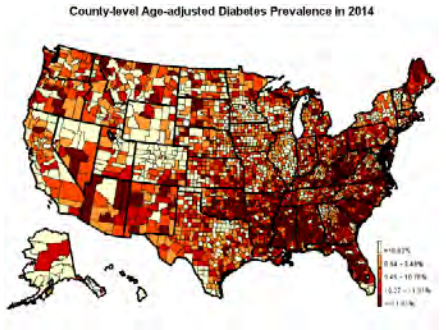
- We thoroughly analyzed ten years of county-level diagnosed diabetes prevalence data spanning from 2011 to 2020 to unravel the hidden patterns. The data is expressed as changes from prevalence in 2011

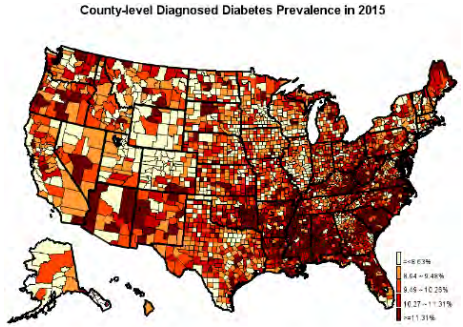
County-level Diagnosed Diabetes Prevalence in the U.S., 2011- 2022

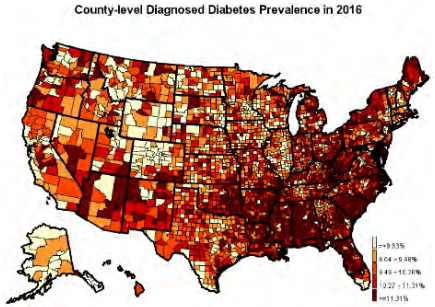


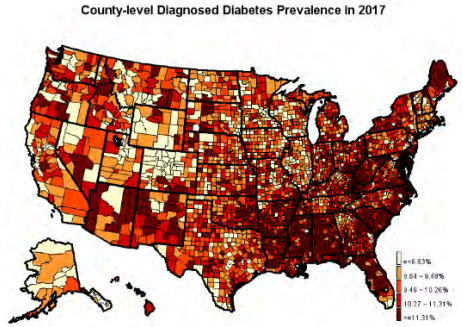


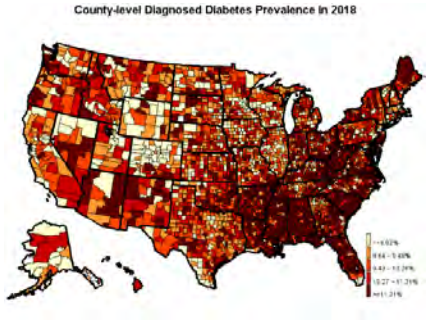


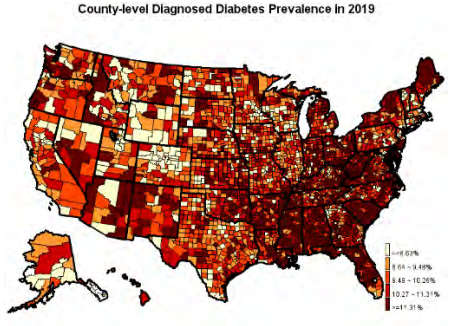


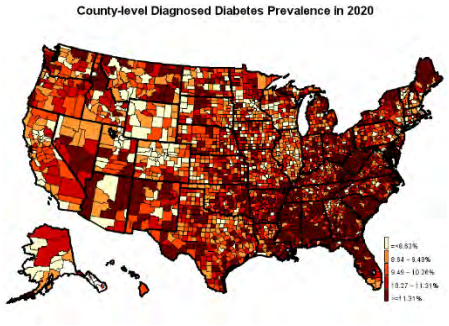


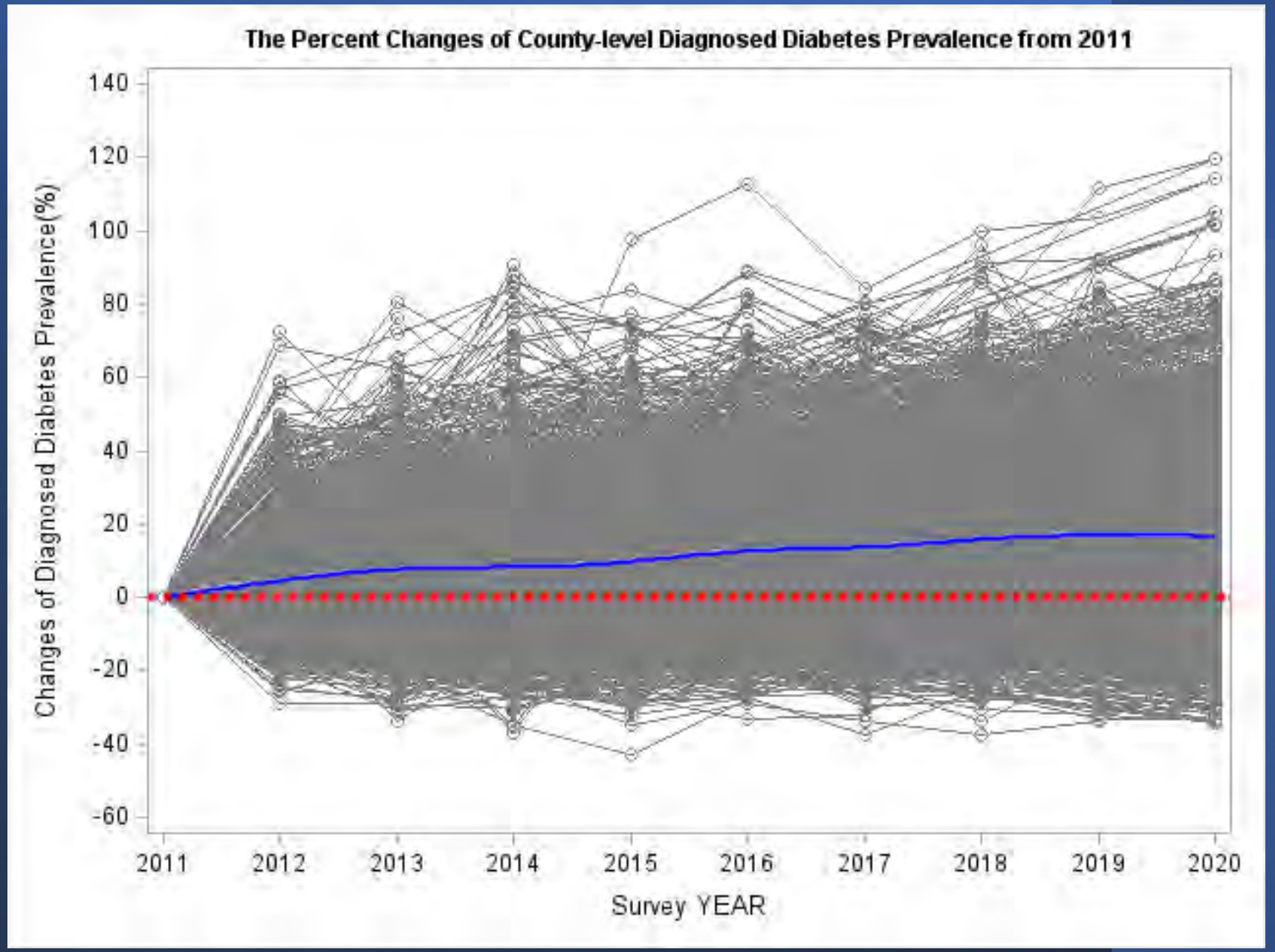











The Percent Changes of County-level Diagnosed Diabetes Prevalence from 2011
Changes of Diagnosed Diabetes Prevalence(%)
140
120
100
80
60
40
20
0
-20
-40
-60
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Survey YEAR

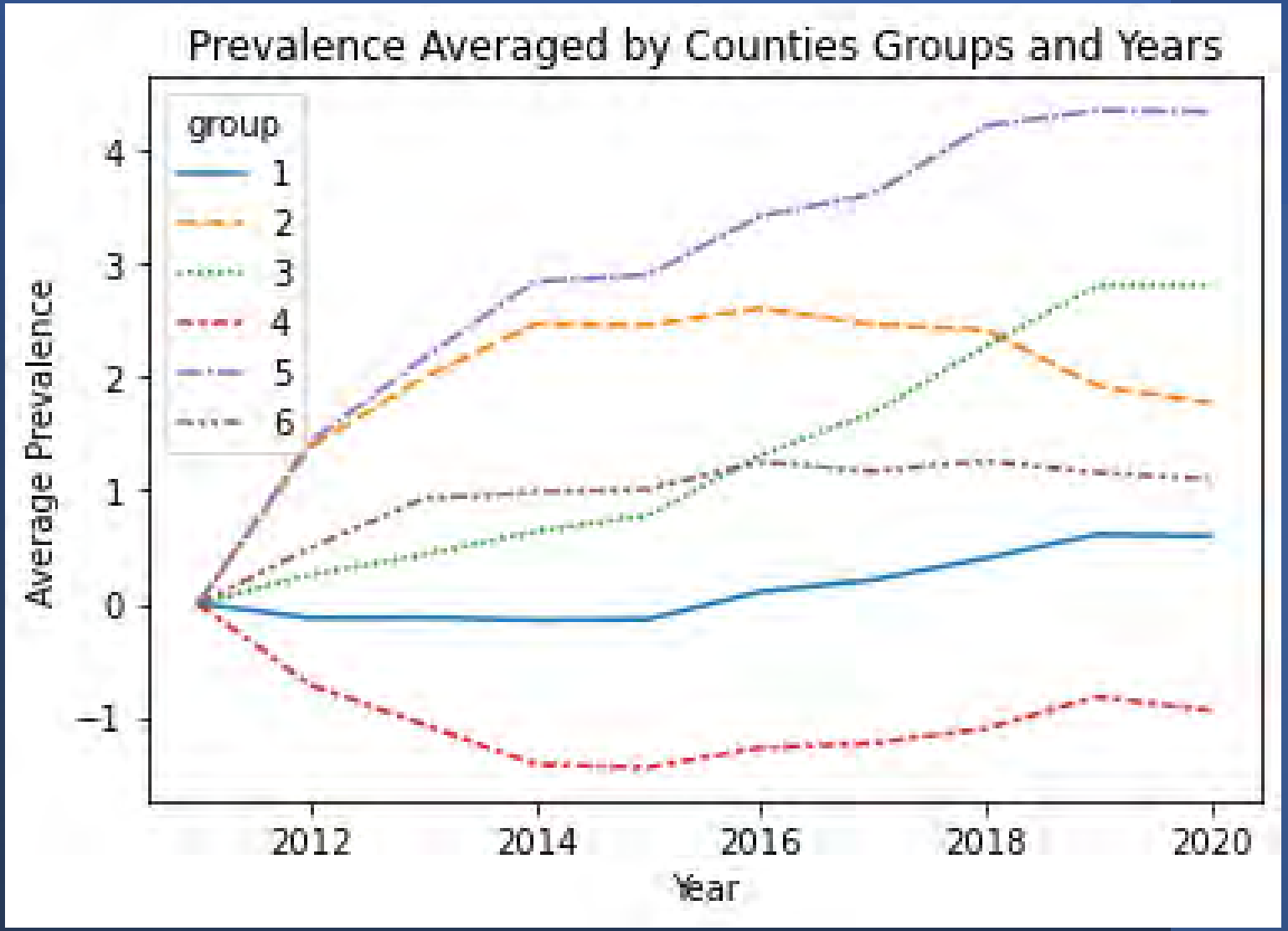
Methods

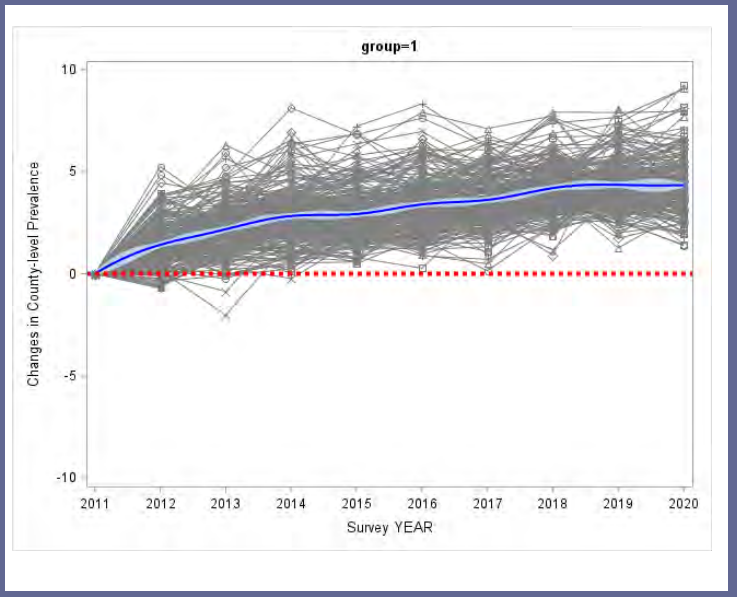
- We applied unsupervised classification, a Neural Network architecture, to identify the patterns within county-level trends across ten survey years.

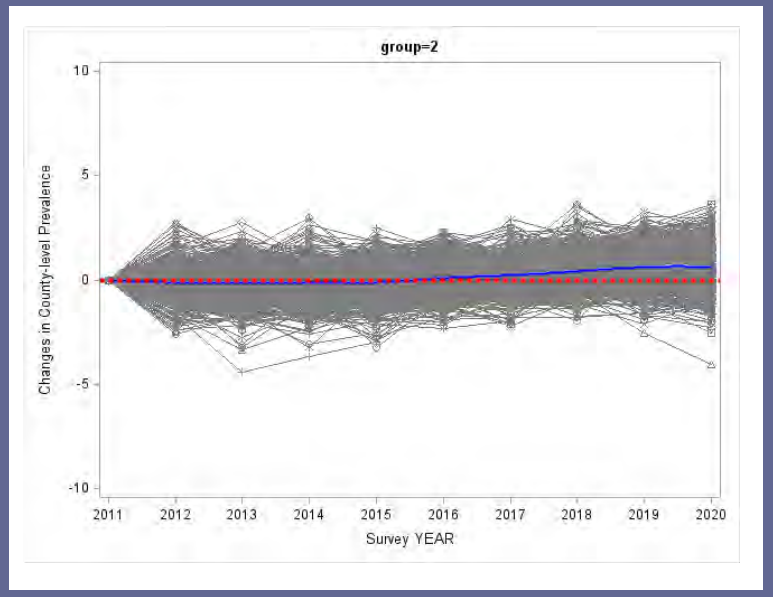
- We then employed a Spatial Autoregressive model to capture the spatial patterns and relationships across counties

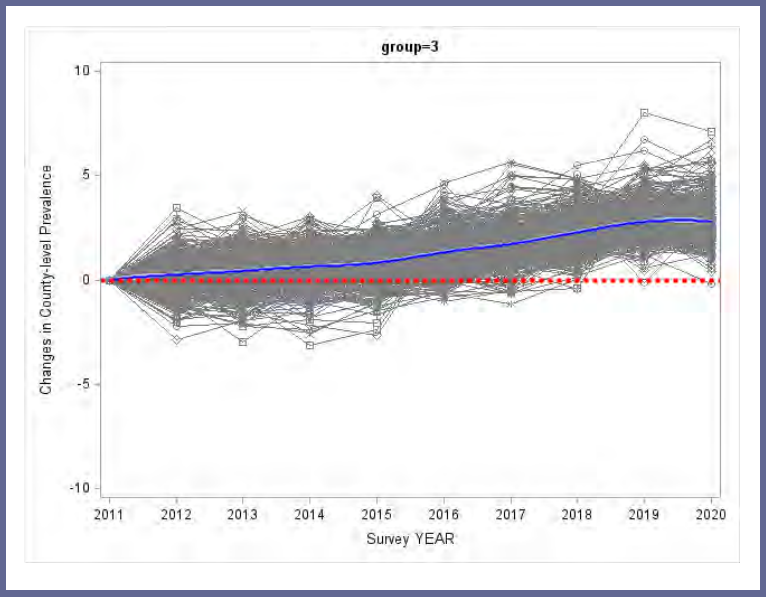
- We assessed the model's performance using appropriate spatial evaluation metrics, including Moran's I, Local Indicators of Spatial Associations (LISA), and spatial cross-validation metrics

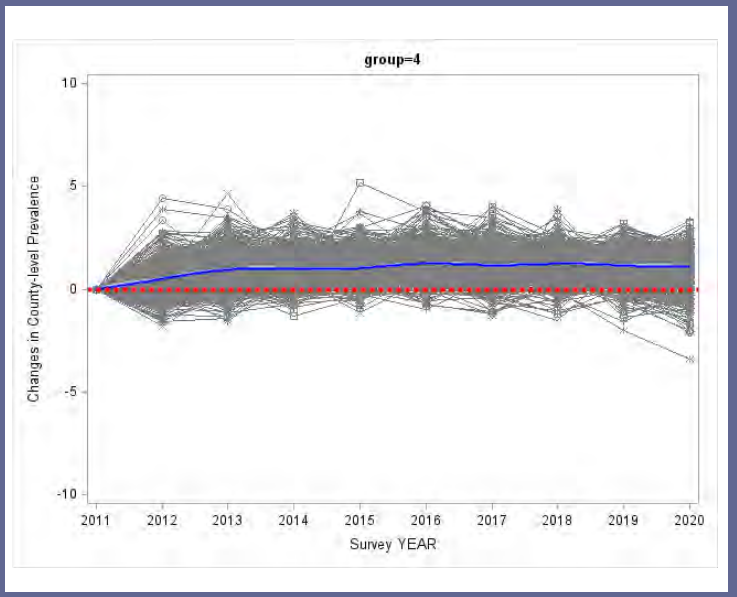
Results I : Temporal Analysis

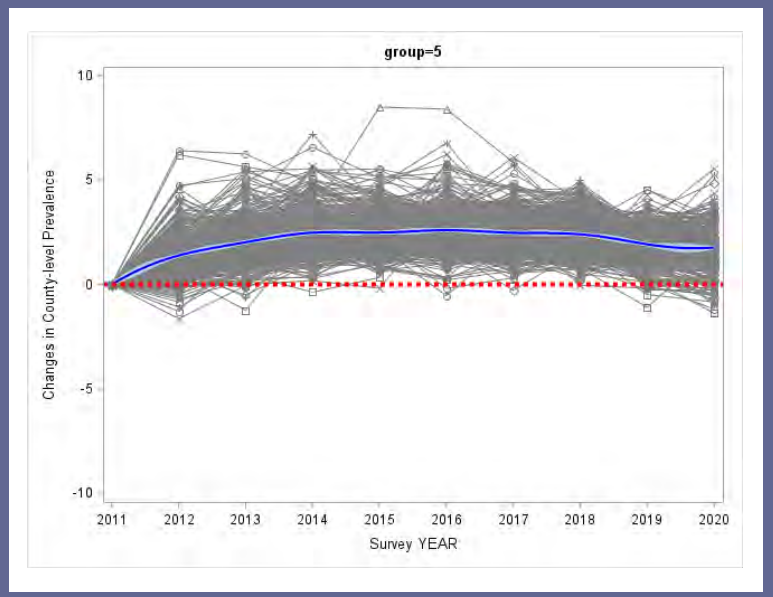

Prevalence Averaged by Counties Groups and Years
group
1
2
3
4
5
6
Average Prevalence
4
3
2
1
0
−1
2012
2014
2016
2018
2020
Year

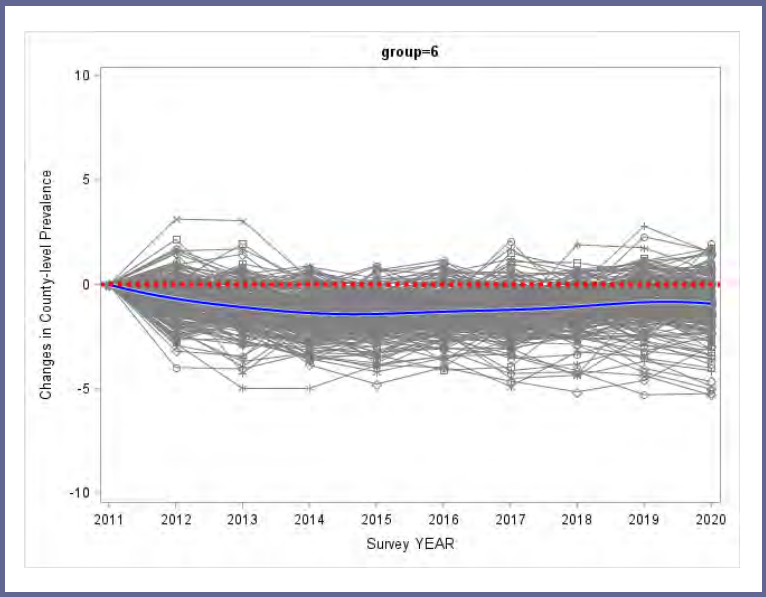

group=1
Changes in County-level Prevalence
10
5
0
-5
-10
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Survey YEAR


group=2
Changes in County-level Prevalence
10
5
0
-5
-10
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Survey YEAR


group=3
Changes in County-level Prevalence
10
5
0
-5
-10
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Survey YEAR

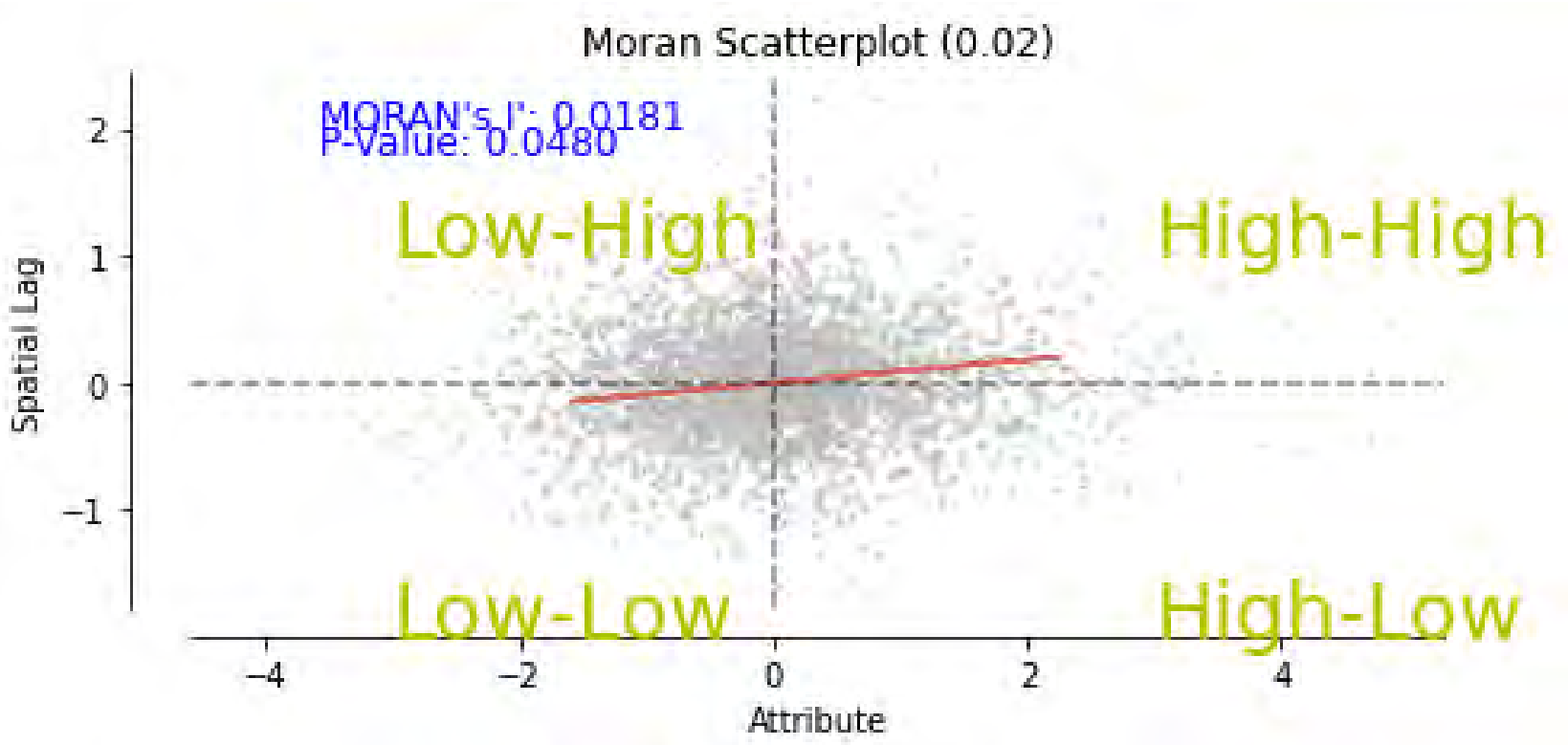

group=4
Changes in County-level Prevalence
10
5
0
-5
-10
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Survey YEAR


group=5
Changes in County-level Prevalence
10
5
0
-5
-10
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Survey YEAR

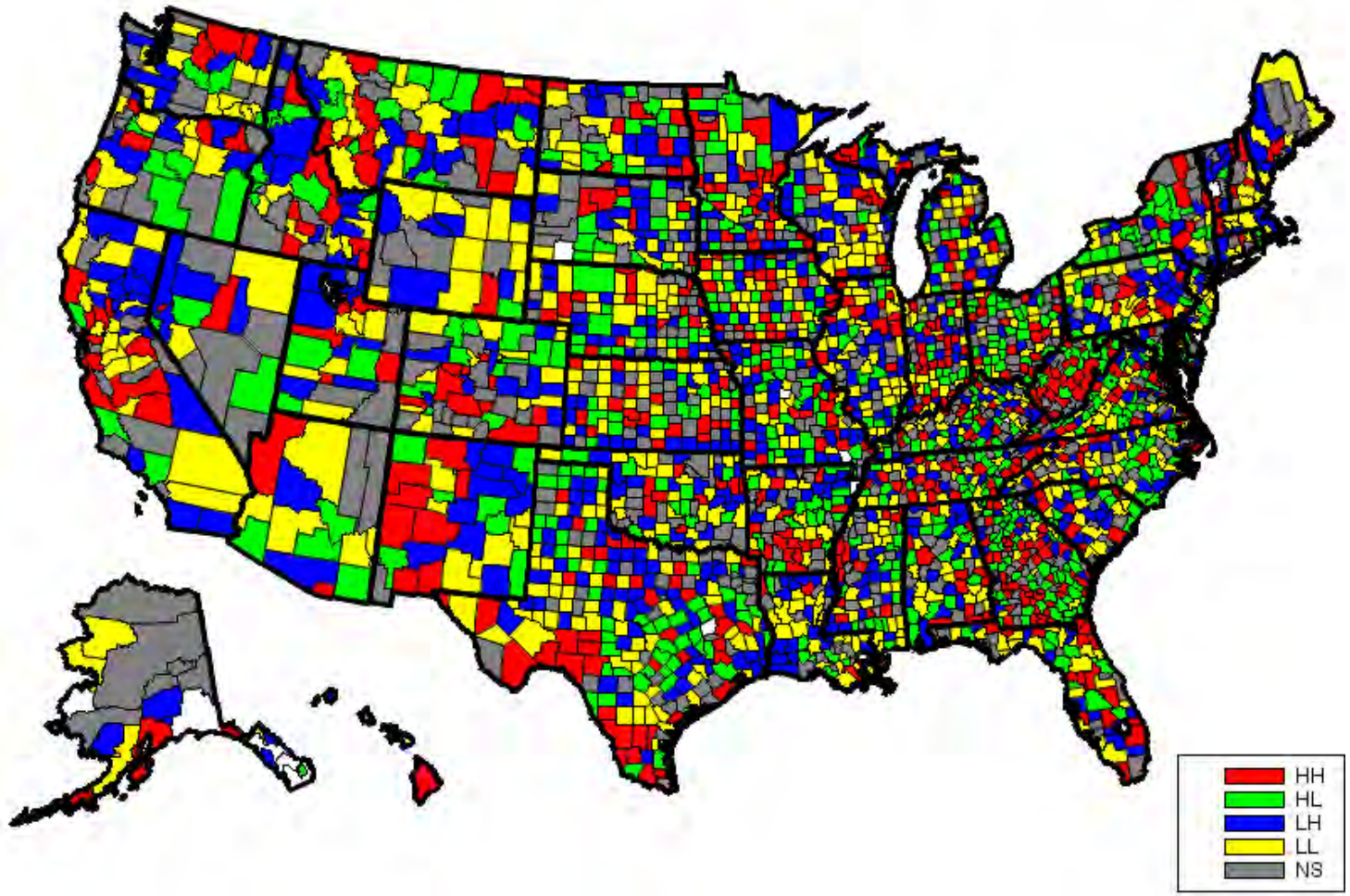

group=6
Changes in County-level Prevalence
10
5
0
-5
-10
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Survey YEAR

Results II. Spatial Analysis

Global Moran’s I



Spatio Patterns of County-level Diabetes Prevalence Trends: LISA Cluster Map



Discussions

- We identified distinct temporal patterns in the trends of county-level diagnosed diabetes prevalence, with 37.62% of counties having a continuously increasing trend, while others displayed more intricate patterns.
- Meanwhile, we observed notable spatial variations, with 22.89% of counties (mostly located in the southeast) having consistently higher changes of prevalence than others.
- The findings provide insights into the temporal and spatial dynamics of diabetes prevalence and could inform targeted interventions to help reduce diabetes prevalence in the most affected areas.
- Two limitations: (1) The analysis covered a ten-year period. A more extended time frame might provide a broader perspective on trends; (2) the uncertainties of county-level estimates by SAE were not counted, which will be considered in future studies

Thank You