Investigating Low MMR Vaccination Rates at California Child Care Facilities Using Ordinary Least Squares Regression

Erika Anderson

GEO 470 – WINTER 2015

Introduction

**Objective:**
- Analyze child care facilities with MMR vaccination rates of <92% in California counties that experienced measles outbreaks in 2014-2015.

**Research Goals:**
- Assess the statistical significance of explanatory variables on low MMR rates.
- Determine potential clustering of schools with low MMR vaccination rates in counties with documented measles outbreaks in 2014-2015.

**Why this is Important:**
- In 2000, the CDC declared measles to be eliminated from the U.S. Measles is no longer endemic (constantly present) in this country. The disease is brought into the U.S. by foreign travelers, traveling from countries where the disease still occurs or where outbreaks are still occurring; this includes countries in Europe, Asia, Africa, and the Pacific. Measles is able to spread and outbreaks are able to occur in the U.S. due to small pockets of unvaccinated or under vaccinated people. Investigating various sociodemographic variables that may be contributing to low MMR vaccination rates in children could help public health agencies target those populations that aren’t vaccinating their children.

**Methods**

MMR vaccination data for child care facilities was obtained through the California Department of Public Health Data Portal. The data was downloaded as an Excel document, and uploaded into ArcGIS as a table. The child care facilities were then geocoded to allow for spatial representation; child care facilities in counties where outbreaks occurred, and facilities with an overall MMR vaccination rate of less than 92% were included. Outbreak data was obtained through the California Department of Public Health’s Measles Surveillance Update – specifically the April 4th, 2015 update. A table was created representing outbreak number per county (Table 1). The table was then uploaded into ArcGIS and joined to a layer of California counties – the California counties layer was obtained through the ERS Department’s server. Census block groups were obtained as TIGER/Line files and the American Community Survey table was then uploaded into ArcGIS and joined to a layer of California counties – the California counties layer was obtained through the ERS Department’s server. Census block groups were obtained as TIGER/Line files and the American Community Survey of 2011 was included with the data as well. Additional Census block group data was obtained through the ERS Department’s server. The childcare facilities layer was the target layer in a join with the Census block data; because of this, Census block data was available for each individual child care facility. Following the join, descriptive statistics were conducted and the variance inflation factor (VIF) was used to test for multicolinearity among the chosen predictor variables (Table 2). Predictor variables were chosen after a literature review of a study which investigated sociodemographic variables and their influence on vaccination rates in Greece. An Ordinary Least Squares Regression was used to test the influence of the predictor variables on the low MMR vaccination rates.

**Results**

Several maps were used to illustrate the extent of low MMR vaccination rates. Figure 1 shows the 2014 & 2015 outbreak totals per county. Figure 2 is an output of the OLS Model, and shows variations from the mean for each childcare facility. Among those childcare facilities which were found to be problematic, Figure 3 illustrates the average MMR vaccination rate in each county among the childcare facilities falling under the 92% threshold. Both maps follow a similar pattern, and show a correlation between low average MMR vaccination rates and the number of outbreaks that were experienced.

The OLS model indicated that all predictor variables were found to be statistically significant (p value < 0.05). (Table 3) The positive coefficients for all four predictor variables indicate a positive relationship to the dependent variable as well. These correlations tell us that - within the parameters of this study – female headed households, living in poverty, having only a high school level education, and identifying as multiracial all positively contribute to a child being unvaccinated with the MMR vaccine.

**Conclusions**

The purpose of the study was to analyze whether certain sociodemographic factors had an influence on low MMR vaccination rates. The study was limited to only those childcare facilities that were registered with the state and those who reported their vaccination rates. The CDC recommends on their website that the first MMR vaccine be administered at 12-14 months, with the second being administered at 4 to 6 years of age. Utilization of kindergarten data would provide a better representation of the actual population that should be studied; because many children leave child care facilities at 5 or 6 for kindergarten, the number of children not included in the study could be vary large. Ordinary Least Squares Regression could be used by public health practitioners in the future to further investigate small pockets of unvaccinated or under-vaccinated children.


---

Table 1. Descriptive Statistics of explanatory variables.

Table 2. Descriptive statistics of predictor variables.

Figure 1. Measles 2014 outbreak number by county.

Figure 2. Map of Ordinary Least Squares Analysis.

Figure 3. Results of the OLS model.