

Examining Vaccine Compliance and Insurance Coverage in Southern California

by

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Master of Public Health, California Baptist University, 2020

Thesis Submitted in Partial Fulfillment

of the Requirements for the Degree of

Master of Public Health

California Baptist University

April 2020

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Abstract

According to the Centers of Disease Control and Prevention (2016), vaccines have been identified as the most effective approach to preventing communicable diseases. However, concerns over vaccine safety have led parents and caregivers to delay or forgo completing vaccines for their children. The World Health Organization (n. d.) has termed the refusal or delay in vaccines despite the availability or access as “vaccine hesitancy.” The aim of this study is to observe if there is a relationship between healthcare insurance coverage and vaccine compliance among kindergarten students in Southern California counties. Additionally, the study examined the relationship between healthcare insurance coverage and vaccine compliance among kindergarten students in Southern California counties and examine if combination shots were associated with overall vaccine compliance. There were two datasets used for the analyses performed: the American Community Survey and the California Department of Public Health Kindergarten Immunization Assessment. A chi-square test for independence test and an independent samples t-test were conducted. Results showed that cities with higher rates of insurance coverage had more kindergarten students meeting compliance rate threshold ($t(306) = 3.192, p = .05$). Furthermore, kindergarten students who did not meet overall vaccine compliance were 17.7 times more likely to have not completed a combination vaccine series. Programs such as Vaccines for Children and policies like SB 277 improve vaccine compliance but do not address fears and concerns over vaccine safety.

Keywords: vaccines, hesitancy, insurance, immunization, and compliance

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Review of Literature

Introduction

According to the Centers for Disease Control and Prevention ([CDC] 2016) and the Advisory Committee on Immunization Practices ([ACIP] 2016), vaccinations are one of the best approaches to protect infants, children, and adolescents from 16 harmful diseases, including measles, polio, mumps, rubella, and tetanus. Worldwide, vaccines prevent two to three million deaths each year (World Health Organization [WHO], 2019). If children are vaccinated on time and according to the CDC's recommended schedule of four to six years of age, then they will be protected from 14 vaccine preventable diseases (CDC, 2020). Once children reach the age of four to six years, they receive vaccines for polio, chickenpox, diphtheria, tetanus, whooping cough, and measles, mumps, and rubella (MMR) (CDC, 2020). During the 2015-2016 school year, the median vaccination rate for kindergartners in the United States was 94.6% for MMR; 94.2% for diphtheria, tetanus, pertussis; and 94.3% for two dose varicella (Seither, Caloun, Mellerson, Knighton, Street, Dietz, & Underwood, 2016).

In 2015, a multi-state measles outbreak linked to Disneyland in California resulted in over 100 infected children (Zipprich Winter, Hacker, Xia, Watt, & Harriman, 2015). A review of the measles cases revealed the majority of children were either not vaccinated or did not complete the MMR vaccination series (Zipprich et al., 2015). In response to the outbreak, California introduced and passed Senate Bill (SB) 277, Public Health Vaccination (SB-277 Public Health, 2015). California SB 277 requires children entering public and private elementary or secondary schools, child care centers, or day nurseries to be fully immunized according to their age

criteria before being granted admission (SB 277, 2015). The law eliminates the ability to use philosophical or religious belief as an acceptable reason not to vaccinate children (SB 277, 2015).

The Senate Bill faced opposition from groups, such as The California Coalition for Vaccine Choice, since it eliminates parental choice in the process of vaccinating children (Children Coalition for Vaccine Choice, 2015). Following the passing of SB 277, the number of California kindergartners with all required vaccinations rose from 92.8% to 95.6% (Karlman & Lin, 2017). However, the Bill does not address the concern of parents and caregivers who believe they are placing their child at unnecessary risk through vaccinations (California Coalition for Vaccine Choice, 2015).

Now, the only allowed exemption to vaccination is a medical exemption, which is defined as a written statement by a licensed physician stating immunization is not safe for the child due to physical or medical conditions (SB 277, 2015). Notably, since SB 277 passed in 2015, the number of medical exemptions for vaccinations rose 250% in California (Mohanty, Bottenheim, Joyce, Howa, Salmon, & Omer, 2018). The rise in medical exemptions also led to a decline in vaccine compliance, which essentially leaves communities at-risk to vaccine-preventable outbreaks (Mohanty et al., 2018).

The largest rise of medical exemptions was seen in counties where individuals previously had high personal beliefs in exemptions prior to SB 277 (Mohanty et al., 2018; Karlman & Gutierrez, 2019). This led the state legislature to introduce SB 276, which would grant authority to California's Health Department to review and

track medical exemptions. The bill creates stronger oversight by requiring physicians to submit a standard form into a statewide database. The information that must be entered includes physician's license number, child's information, child's primary care physician, description of the medical condition, whether the medical condition is temporary or permanent, and how long the physician has been seeing the child. A clinically trained immunization physician, surgeon, or registered nurse at the California Department of Public Health reviews exemptions annually (at a minimum). The designated department staff identify medical exemptions that do not meet applicable criteria as outlined by the CDC, ACIP, or American Academy of Pediatrics. The department staff have the authority to revoke exemptions if they are not deemed appropriate as outlined in the SB 276. In addition, if the department determines that the physician writing the exemption is contributing to a public health risk by issuing invalid medical exemptions, the department will report the physician to the California Medical Board or the California Osteopathic Medical Board. Currently under SB 277, local health jurisdictions do not have authority to review and track medical exemptions (Mohanty et al., 2018).

Access to Vaccinations

Health insurance coverage has been recognized as a disparity that can significantly limit access to preventative healthcare services, such as vaccines for children and families (King, 2016). Healthy People 2020 has recognized improved access to healthcare services as a goal, recognizing healthcare access as important to an individual's overall health status and quality of life (Office for Disease Prevention and Immunization, n. d.). One component of access to healthcare services is to ensure

the community has an ongoing source of care to receive services, such as childhood vaccines (Office for Disease Prevention and Immunization, n. d.).

Access to health services is a complex subject and can be defined and measured in various ways, such as geographical accessibility, affordability, and physical availability (WHO, 2014; Levesque, Harris, & Russell, 2013). Geographic accessibility greatly impact health outcomes for individuals. However, community pharmacies increase the availability and access of vaccine services to both rural and urban areas (Bach & Goad, 2015). Pharmacists are one of the most accessible healthcare professionals for 93% of Americans and they are able to take on the role of immunizer, which has resulted in increased immunization rates (Bach & Goad, 2015). For example, from 2011-2012, 20.1% of US adults received their influenza vaccine from a supermarket or drug store (Bach & Goad, 2015).

Access to health services can also be determined by an individual's ability to afford care (WHO, 2014; Levesque et al., 2013). In order to obtain health services, individuals must have the ability to access them both economically and geographically. Individuals who have access to ongoing, consistent care tend to have better health outcomes; moreover, consistent access to healthcare providers creates better communication, trust, and continuity in care (Office for Disease Prevention and Immunization, n. d.). Barriers to health services include high healthcare costs, inadequate or no insurance coverage, lack of available services, and lack of culturally competent care (Office for Disease Prevention and Immunization, n. d.).

In the US, the program Vaccines for Children (VFC) was created to provide free vaccines to children who may not be able to afford it (National Center for Health

Research, 2019). For example, the cost of the MMR vaccine in the private sector can range from \$78.67 to \$224.93, which can create a significant barrier for those who are unable to afford the out of pocket cost (CDC, 2020). The lack of healthcare coverage has significant implications and can lead to poorer health (Kuo, Etzel, Chilton, Watson, & Gorski, 2012).

Vaccine Hesitancy

Vaccine hesitancy is a behavioral phenomenon that occurs in populations who refuse or are reluctant to take vaccines despite the availability of vaccine services (WHO, 2019). As a result, vaccine hesitancy runs contrary to the belief that the availability to healthcare services leads to better health outcomes. The concern for adherence to childhood vaccines is not unique to the US. Vaccine hesitancy is one of the top ten global threats according to the WHO (2019). The Strategic Advisory Group of Experts (SAGE) on Immunization established a working group in order to research vaccine hesitancy in developing and non-developing countries (WHO, 2014). The group identified that vaccine hesitancy is influenced by complacency, convenience, and confidence (WHO, 2014). Vaccine complacency is when the risk of the vaccine preventable disease is perceived as low, so the individual does not consider it to be necessary (WHO, 2014). Vaccine convenience is assessed by various factors: physical availability, geography, affordability, willingness to pay, and literacy (WHO, 2014). Concerning confidence is defined as trust of the safety, of the system that delivers the vaccine, and in policymakers (WHO, 2014). Some parents/caregivers do not trust in the information they receive from healthcare professionals, which leads them to utilize other outlets, such as social media, as a

resource to gather information when making decisions about their child's vaccines (Bolton, Memory, & McMillan, 2015). The need to seek out health information through social groups is due to parents' low confidence in vaccines and their mistrust of their healthcare providers (Bolton et al., 2015; Larson, Smith, Paterson, Cumming, Eckersberger, Freifeld, Ghinai, Jarrett, Paushter, Brownstein, & Madoff, 2013). According to the SAGE group, attitudes towards vaccines are on a continuum from total acceptance in receiving vaccines to complete refusal (WHO, 2014). People who have a hesitancy toward vaccines fall in the middle of this continuum (WHO, 2014). These individuals can possibly choose to receive, delay, and/or refuse some vaccines (WHO, 2014).

Concerns over Combination Shots

There are several reasons for low confidence in vaccines. Some mistrust comes from the concerns over ingredients in vaccines, adverse effects, or the vaccine schedule itself (Baker, 2008). Additionally, there are concerns regarding substances, such as thimerosal which is used as a preservative in DTaP and one DTaP-HIB combination vaccine (CDC, 2013). Some parents fear that the toxicity from exposure to thimerosal in childhood vaccines has yet to be determined (Geier, Sykes, & Geier, 2007).

The California Coalition for Vaccine Choice (2015) has also noted some parents' concern for the increase in the number of vaccines given to children and the reported number of adverse events reported on the CDC website. The group has stated concern for the number of new vaccines in development that may or may not be mandated (California Coalition for Vaccine Choice, 2015). They specifically cited

that the number of vaccines from the year 2000 to today has doubled on the childhood vaccine schedule. The group stated that there are hundreds of new vaccines in development for diseases, such as HIV, herpes, E. coli, tuberculosis, and small pox, and there is concern that these will be added to the childhood vaccine schedule. The group also cited that requiring vaccines infringes on parental rights. They believe that parents should have the same rights as physicians since the American Medical Association's Code of Ethics has affirmed philosophical and religious exemptions for physicians. The members of the California Coalition for Vaccine Choice believe that parents should share the same rights that physicians have in regards to philosophical and religious beliefs.

It cannot be dismissed that there are possible adverse effects after receiving a vaccine dose. According to the CDC (2015), a possible side effect of the MMR vaccine is febrile seizures. However, there is a very low risk for serious side effects to the MMR vaccine, and many health professionals agree that the risks from receiving the vaccine outweigh the possibility of contracting the diseases it prevents (CDC, 2015). Risk for anaphylaxis caused by vaccines is less than two cases per million doses of vaccines administered to children and adolescents (Miller, Moro, Cano, & Shimabukuro, 2015). Overall, common adverse effects to vaccines are mild and not serious as they are considered one of the safest medical products (Miller et al., 2015). Although rare, serious adverse effects can and do occur, such as death, prolonged hospitalization, coma, and life-threatening illnesses (Miller et al., 2015). One of the most notable, although widely disproven, vaccine concerns relates to the MMR vaccine, which has been suspected to cause autism due to the timing of first

administration of the vaccine to first signs of behavioral symptoms of autism at approximately 15 months of age (Roberts & Hartford, 2002).

Purpose of the Study

The purpose of this investigator-initiated study was to observe if there is a relationship between healthcare insurance coverage and vaccine compliance among kindergarten students in Southern California counties. The study examined healthcare insurance coverage in Southern California and the percent of vaccine compliance for combination shots and single agent shots among kindergarten students.

Research Questions

This study answered two research questions in order to measure vaccine hesitancy in Southern California:

1. Is there a difference in the rate of insurance coverage between those compliant with vaccine requirements compared to those who are non-compliant?
2. Is the use of combination shots associated with vaccine compliance?

Hypotheses

There are various factors that may contribute to vaccine compliance. This research will explore the relationship of healthcare insurance coverage and its effect on immunization compliance.

H₁: There are higher rates of healthcare coverage among communities that meet the vaccine requirement.

H₂: The use of combination shots leads to higher vaccine compliance.

Method

Design

This study used a cross-sectional design to examine the relationship between health insurance coverage and vaccine compliance among kindergarten students in Southern California communities. Secondary data was utilized from two sources, the 2018 American Community Survey and the 2017-2018 California Department of Public Health (CDPH) Kindergarten Immunization Assessment.

Procedures

The American Community Survey (ACS) is a nationwide survey that continuously collects data in monthly samples from the same small areas to produce annual estimates (U.S. Census Bureau, 2019). The estimates are released annually and provide estimates on subjects such as the education, employment, healthcare coverage, internet access, and other topics not included on the 2020 Census (U.S. Census Bureau, 2019). The survey is conducted by the US Census Bureau in an effort to provide communities with demographic, social, economic, and housing data each year (State of California Department of Finance [DOF], 2019). The data for each housing unit and group quarters are captured in various phases. First, housing units are requested to respond online, next by paper questionnaire, then by a computer-assisted telephone interviewer, and then by a computer-assisted personal interview.

In the first phase of the survey collection, the US Census Bureau sent a letter notifying households that they have been selected for the ACS (US Department of Commerce, Bureau of Census, 2014). The letter included instructions to complete the survey online. If the household did not complete the survey, the US Census Bureau

followed up with a paper version of the ACS after approximately two weeks (US Department of Commerce, Bureau of Census, 2014). Follow-up via a phone call may have occurred if the paper version was not completed and sent back or if there was any clarifying information needed (US Department of Commerce, Bureau of Census, 2014). If the previous attempts to reach the household were unsuccessful, a Census representative visited the household in person to conduct the interview (US Department of Commerce, Bureau of Census, 2014).

All information provided is confidential (US Department of Commerce, Bureau of Census, 2014). Households interviewed are classified as either a housing unit or a group quarter. A housing unit can be classified as separate living quarters in which occupants live separately (i.e. house, apartment, and mobile home). Group quarters are classified as group living facilities that can be managed by an entity or organization (i.e. skilled nursing facility). The California State Data Center creates reports from the data files released by the US Census Bureau (DOF, 2019).

The California Department of Public Health (CDPH) Kindergarten Immunization Assessment is data provided by all California schools registered with the California Department of Education. The California Health and Safety Code 120325-75 requires that all students provide proof of immunization for school entry (CDPH, 2019). Immunization records are provided to school nurses for assessment. The California Health and Safety Code 120375 and California Code of Regulation 6075 require all schools to report an annual assessment of the immunization status of their enrollees (CDPH, 2019). This data is reported electronically beginning in mid-September to November first of each year (CDPH, 2019). The data collected

measures compliance with California immunization law across all public and private schools (CDPH, 2019).

Participants

The data of percent vaccine compliance was derived from 388 cities and unincorporated areas within the Southern California counties of Los Angeles, Orange, San Diego, San Bernardino, Riverside, Kern, Imperial, Santa Barbara, San Luis Obispo, and Ventura. While there is no official agreed upon definition of Southern California, for the purpose of this study Southern California was defined by the counties that are geographically located in California's southernmost region (Center for Health Policy at Brookings, 2017). The ACS only includes cities with a population size of 65,000 and above. Cities with less than 65,000 residents are not included in the dataset. Using G*Power software, a medium effect size, and a power of 80%, the minimum required sample sizes required to answer the research questions in this study was 128. The sample size of 388 exceeds the minimum requirement for sufficient statistical power.

Independent Variables

There are two independent variables in this study: combined shot vaccine compliance and overall vaccine compliance. The first variable, overall vaccine compliance, was measured by each city's vaccine compliance of greater than or equal to 95% designated as a categorical variable with two possible responses of compliant or non-compliant. Cities that were designated as compliant had an immunization rate of 95% or greater compliance and coded as 1, while cities that had an immunization rate of below 95% were coded as 0. The second independent variable, compliance

with combination shots, was created by combining responses of compliant versus non-compliant to meeting immunization rate of 95% rate or greater and by combining the responses for MMR and DPT. The variable compliance with combination shots was also a categorical variable with two possible response options. Vaccine compliance with both MMR and DPT vaccines were coded as a 2, while compliance was for one or no vaccine was coded as a 1.

Dependent Variables

There were two dependent variables in this study: healthcare insurance coverage for each of the cities in Southern California and overall vaccine compliance. The first dependent variable, healthcare insurance coverage, is a continuous variable measured by the estimated percent insured civilian noninstitutionalized population from the ACS five-year estimate (US Department of Commerce, Bureau of Census, 2014). The second dependent variable, overall vaccine compliance, was measured by each city's vaccine compliance of greater than or equal to 95%. The second dependent variable was designated as a categorical variable with two possible responses of compliant and non-compliant. Cities designated as compliant had an immunization rate of 95% or greater compliance and were coded as 1, while cities that had an immunization rate below 95% were coded as 0.

Data Analysis

Data in this study was analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. To answer the first research question, "*Is there a difference in the rate of insurance coverage in between those compliant with the vaccine requirement compared to those that are non-compliant?*", an independent

samples t-test was performed. To answer the second research question, “*Is the use of combination shots associated with vaccine compliance?*”, a chi-square test for independence test was performed.

Results

Demographics

To evaluate the research questions in this study, data was analyzed in SPSS version 26.0 using data from the 2018 American Community Survey and the 2017-2018 California Department of Public Health Kindergarten Immunization Assessment. There was a total of 388 cities (cases) included in this study. Out of the counties included in this study, Los Angeles County had the highest population size and Imperial County had the smallest population size. However, Imperial County had the highest percentage of children under the age of six years. Los Angeles had the highest number of adults (19-64 years) in the labor force, and Imperial County had the lowest amount. However, Orange County had the highest percentage of individuals (19-64 years) in the labor force and Imperial County had the least.

Insurance and Overall Vaccine Compliance

To assess the first research question, *“Is there a difference in the rate of insurance coverage between those compliant with the vaccine requirement compared to those that are non-compliant?”*, an independent samples t-test was conducted to compare healthcare insurance coverage for public elementary schools meeting overall vaccine compliance and public elementary schools that did not meet overall vaccine compliance. The results showed a statistically significant difference in the rate of insurance among cities ($t(306) = 3.192, p = .05$) that met the vaccine compliance requirement ($M = 91.04, SD = 4.51$) compared to those non-compliant ($M = 93.30, SD = 3.85$).

Combination Shots and Overall Compliance

A chi-square test of independence was performed to examine the relationship between combination shots compliance and overall compliance. The relationship between the two variables was significant ($X^2(1, N = 380) = 248.69, p < 0.001$). Those kindergarteners living in cities that did not meet the overall vaccination compliance standard were 17.7 times more likely to have not received the combination shot (see Table 1). This result suggests that the use of combination shots can be associated with overall vaccine compliance among kindergarten students.

Table 1

Bivariate Association between Overall Vaccine Compliance and Combination Shot Compliance

Combination Shots	No N (%)	Yes N (%)	OR (95% CI)
Greater or equal to 95 Percent	0 (0%)	318 (94.4%)	17.78 **
Less than 95 Percent*	43 (100%)	19 (5.6%)	(11.46-27.45)

Note. OR, odds ratio, CI, confidence interval. Chi-square test was used to assess the relationship between kindergarteners who met vaccine compliance and received combination shots. *Referent group. ** $p < 0.0001$

Discussion

Summary of Major Findings

The purpose of this study was to examine if there was a relationship between healthcare insurance coverage and vaccine compliance among kindergarten students in Southern California counties. Additionally, this study examined the relationship between overall vaccine compliance and completion of combination vaccine series among kindergarten students. The study examined the 2018 ACS and the 2017-2018 California Department of Public Health Kindergarten Immunization Assessment results from 388 cities and unincorporated areas, which had diverse economic statuses, ethnic groupings, and population sizes.

For the first research question, *“Is there a difference in the rate of insurance coverage between those compliant with the vaccine requirement compared to those that are non-compliant?”*, the results showed that in cities where there were higher rates of insurance coverage, there was a 95% overall vaccine compliance rate among kindergarten students enrolled in public elementary schools despite the phenomenon of vaccine hesitancy observed in other parts of the world. These findings aligned with results from previous studies. For example, in a study examining the relationship between health insurance and vaccine coverage among adolescents, it was found that vaccine coverage was lower among uninsured populations (Lu et al., 2018). This finding also supports the hypothesis that there are higher rates of healthcare coverage among communities that meet the CDC’s schedule of vaccination. This can then be aligned with Healthy People 2020 assessment that healthcare coverage helps populations gain access to medical services, such as vaccines (Office of Disease

Prevention and Immunization, n.d.). Barriers to healthcare services, such as lack of insurance coverage, can result in poorer health outcomes (WHO, 2014; Levesque et al., 2013; Kuo et al., 2012). Finally, these results also suggest that having access to medical services leads populations to better healthcare outcomes, which then strengthens communities' ability to prevent illness (Office of Disease Prevention and Immunization, n.d.).

For the second research question, "*Is the use of combination shots associated with vaccine compliance?*", the results show that kindergarten students who did not meet overall vaccine compliance were 17.7 times more likely to have not completed a combination vaccine series. If students do not meet compliance with combination shots, then, according to these results, it appears to be related to their overall vaccine compliance. Of those kindergarteners within the cities included who were overall vaccine compliant (N = 318), 100% completed the combination shot. There were 89% of cities that were compliant with combination shots and 85% that met overall vaccine compliance. The results from this study align with the hypothesis that the use of combination shots leads to higher rates of vaccine compliance. The results may provide further evidence to support that there is a concern among parents over the safety of additives found in combination vaccines, such as thimerosal (Geier et al., 2007). Possible concerns regarding the adverse effects of a combination shot and additives may have been associated with the decision to vaccinate. Parents and caregivers fear exposure to additives, such as thimerosal, can cause toxicities in their children (Geier et al., 2007).

Study Limitations

This study had several limitations that need to be examined. First, some cities included in the immunization assessment were not accounted for in the 2018 American Community Survey. This was due to the 2018 ACS only including cities with population sizes of 65,000 or greater. Due to this criteria, smaller cities were under-represented. Additionally, the data is not representative as data for the Public Healthcare Kindergarten Immunization Assessment is made up of data reported by schools. However, many private schools did not report complete vaccine compliance numbers and were therefore excluded from this study; more specifically, approximately 640 private schools in California were excluded from this study. A third limitation is the categorization of the data. Grouping immunization data for cities using a threshold of 95% or greater and grouping insured categorically instead of by percentage limits the ability to understand the true relationship between insured status and immunization compliance.

Public Health Implications

The findings of this study demonstrate a relationship between healthcare insurance coverage and vaccine compliance. Additionally, this study demonstrates that compliance of combination vaccines is related to overall vaccine compliance. Several public health implications can be identified from the results of this study. First, healthcare insurance coverage can be a barrier to access to preventative health such as vaccines. Studies examining the relationship between access to healthcare services and vaccine compliance by zip code rather than city may provide different results and understanding of what is occurring in the communities. However,

programs, such as Vaccines for Children, provide vaccines for children at no cost for families unable to pay for the vaccines (CDC, 2019). The VFC is an additional resource for lower socioeconomic communities to use to increase vaccine access among their populations. The results from this study also suggest that policies, such as California SB 277 which requires children entering public and private elementary schools to be fully vaccinated in order to be granted admission, have a positive association with vaccine compliance rates (SB-277 Public Health; County of Los Angeles Public Health Department, 2015). Keeping programs and policies such as these are imperative for maintaining and increasing vaccine compliance. The results from this study, however, do not address the fear or hesitancy that parents or caregivers have regarding vaccine safety. Future studies examining the relationship between parents' and caregivers' views on vaccine safety and delay or refusal of vaccines need to be conducted. Although vaccine compliance appears high, fear and hesitancy can negatively impact current or future success in meeting vaccine compliance.

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