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Trends in Personal Belief Exemption Rates among Alternative Private Schools: Longitudinal Analysis of Waldorf, Montessori, and Holistic Kindergartens in California: 2000-2014.

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By

Julia M. Brennan

B.S., Colorado State University, 2014

Thesis Committee Chair: Saad B. Omer, MBBS, MPH, PhD

An abstract of
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2016

Abstract

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By Julia M. Brennan

Purpose: Personal belief exemptions to immunization requirements among kindergarteners in the United States have increased in popularity in recent years. The objective of this study was to evaluate trends in personal belief exemption rates for private schools in California that follow alternative educational methods, focusing on Waldorf, Montessori, and holistic education methods.

Methods: We used California Department of Public Health data on personal belief exemptions rates for private and public elementary schools for the 2000-2001 to 2014-2015 school years. Generalized estimating equations were used to model annual average increases in personal belief exemption rates, and to assess whether alternative schools had higher rates of personal belief exemptions.

Results: Over the study period, all alternative schools had an average personal belief rate of 8.7% compared to 2.1% among public schools (incidence rate ratio [IRR]: 3.6, 95% CI:2.9, 4.4). The highest average personal belief exemption rate was observed among Waldorf schools (mean PBE rate = 45.1%), and was 19 times higher than the average public school rate (IRR: 19.1, 95% CI: 16.4, 22.2). The average annual increases in personal belief exemption rates for Montessori schools and holistic schools were slightly higher (Montessori: 8.8%, 95% CI: 6.3-11.4%; Holistic: 7.1%, 95% CI: 4.5-9.7%) than among Waldorf schools (3.6%, 95% CI: 2.6-4.6%). The average annual increase in personal belief exemption rates for public schools was 7.3% (95% CI: 7.0. 7.6%).

Conclusions: Rates of personal belief exemptions among private alternative schools in California were high, and continued to increase across the 2000-2001 to 2014-2015 school years.

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Chapter I. Background & Literature Review

Section 1 – Nonmedical exemption rates in the U.S.

In the United States, the introduction and widespread use of childhood vaccines has been responsible for the prevention of infectious disease in the 20th century. In fact, by the end of the 1970s all 50 states had at least some form of a law requiring vaccination before children could attend school, in efforts to control outbreaks within schools and protect communities against the spread of vaccine-preventable diseases, such as measles, pertussis, polio, diphtheria, chicken pox, and smallpox (1). Despite the successes of immunization programs, vaccine hesitancy has been on the rise in the United States towards the close of the 20th century and beginning of the 21st century (2). In the 1980s, concerns arose over the safety of childhood vaccines after issues about the safety of the pertussis vaccine were brought into the public eye (3). It is becoming more common for parents to seek exemptions for their children from state kindergarten immunization requirements for non-medical reasons. In fact, forty-eight states currently allow non-medical exemptions to these immunization requirements (2). Nonmedical exemptions can include religious and personal belief exemptions. Forty-eight states allow religious exemptions; only Mississippi and West Virginia do not allow religious exemptions from immunization requirements (2). Twenty states allow exemptions from immunization requirements due to philosophical or personal beliefs held by the parents, referred to as personal belief exemptions (2). According to one review, three main personal beliefs drive parents to oppose vaccine requirements: vaccines are

unsafe or ineffective, causing harm to those who receive them, vaccinations are unnecessary because the disease they are designed to prevent are rare or not serious, and lastly that these requirements are seen as an unjust intrusion of the government into private and personal affairs (1).

Exemptions to childhood immunization requirements for nonmedical reasons have increased in recent years (4, 5). The rate at which parents claim these nonmedical exemptions for their children has accelerated in the last couple of decades (4, 6). Among California kindergarteners, the rate of nonmedical exemptions increased overall from 1994 to 2009 (7). After examining rates of personal belief exemptions specifically, the rate of personal belief exemptions across California increased an average of 9.2% per year, increasing from 0.6% in 1991 to 2.3% in 2004 (7). Additionally, it was found that the increase in nonmedical exemption rates in Colorado was entirely due to an increase on parents seeking personal belief exemptions (8).

The type of nonmedical vaccine exemptions allowed in states seems to be linked with increasing trends in overall exemption rates. States that allowed personal belief exemptions had higher rates of nonmedical exemptions than states that only allowed religious exemptions (6). The mean exemption rate increased on average 6% per year in states that allowed personal belief exemptions, resulting in an increase from an exemption rate of 0.99% to 2.54% from 1991 to 2004 (6).

The decline in widespread immunization in communities poses a risk to the protection of the community against vaccine preventable diseases. The concept of “herd immunity” is crucial when considering the impact of exemptions

on vaccine-preventable diseases. In a community with low exemption rates to immunization requirements and high rates of childhood immunization, “herd immunity” will be achieved within that population. High exemption rates threaten herd immunity in local communities, even when statewide immunization rates seem sufficient (9).

At the school-district or county level, immunization coverage may not be high enough to achieve adequate herd immunity, which can result in gaps in ideal coverage to protect against vaccine-preventable diseases (9). The past successes of immunization programs to protect children from serious infectious disease, such as measles and polio, may be threatened in communities with these increasing exemption rates (9). Studies have demonstrated associations between high rates of exemption to immunization requirements and greater incidence of vaccine-preventable diseases (6, 8, 10). In New York, counties with higher rates of religious exemptions were demonstrated to have a greater incidence of pertussis (10). In a larger study across the United States, states that allow personal belief exemptions also have increased incidence of pertussis (6).

These increasing exemption rates pose health risks to both individuals and communities. Lower immunization coverage can increase the risk of individuals both acquiring and transmitting vaccine-preventable diseases (2). Refusal of vaccines has been associated with outbreaks of varicella, pneumococcal disease, measles, pertussis, and *Hameophilus influenza* Type b (Hib) disease (11). An early study examining the incidence of measles nationwide found that children with exemptions to immunization requirements were 35 times more likely to contract measles than vaccinated children (12). A study in Colorado

demonstrated that children with a personal belief exemption had a 22.2 times higher risk of getting measles and a 5.9 times higher risk of getting pertussis, compared with children who were vaccinated (8). Increased incidence of pertussis has also been attributed to vaccine refusal, demonstrating that low vaccination rates pose a risk of individuals acquiring and spreading vaccine-preventable diseases (13, 14).

On the community level, exemption rates can be linked with outbreaks of vaccine-preventable diseases. In Colorado, exemptions to immunization requirements were associated with the incidence of measles at the county-level, and schools that had outbreaks of pertussis and measles in Colorado had higher rates of exemption to immunization requirements (8). In Michigan, clusters of nonmedical exemptions were highly correlated with reported incidence of pertussis, at the census tract level, even after adjusting for demographic variables (15). In a review of measles cases in the United States after measles was officially eliminated, about 70% of unvaccinated measles cases had nonmedical exemptions (16). Moreover, vaccine refusal was associated with increased risk of measles not only among people who refused vaccines but also among fully vaccinated people (16). It is also important to note that a state can have a high overall immunization rate, but less vaccinated communities within a state can still pose significant threats to public health. Michigan has a high level of immunization against pertussis, but its high level of protection can break apart when communities within the state are examined more closely (15).

Section 2 – Clustering of nonmedical exemptions

It is important to be aware that heterogeneous trends in exemption rates in individual communities may be undetectable at the state level (15). Studies have demonstrated that children with vaccine exemptions tend to be clustered geographically, possibly due to community factors. These clusters may be undetectable in an examination of state-level data, but are noticeable in individual communities (6). In California, 39 geographic clusters were identified where nonmedical exemption rates were high (17). This social clustering of exemption poses the risk of outbreaks of vaccine-preventable disease (6).

Since these children with vaccine exemptions are clustered based on social factors, it will be crucial to further identify the community characteristics that these exempt children may share. What factors may influence whether or not a child has a nonmedical vaccine exemption? Specific community factors among student populations have been found to be associated with high personal belief exemption rates. Clusters of children with nonmedical exemptions in California were associated with factors commonly associated with high socioeconomic status: lower average family size, lower population density, lower percentages of racial minorities, higher percentage of higher education graduates, higher median household income, and lower percentage of families in poverty (17). In Arizona schools with the highest personal belief exemption rates were associated with schools that had high proportions of white students, schools that had low prevalence of students utilizing free or reduced lunches, and charter schools (18). Personal belief exemption rates were previously positively associated with

schools with high percentages of white students, schools with charter status, and private schools in California (19).

Several studies have made a connection between affluence and increasing personal belief exemption rates (20-22). In a study using data from the National Immunization Survey from 1995-2001, unvaccinated infants were demonstrated to be more likely than vaccinated infants to be white males born to married mothers of age at least 30 years of age who are college educated, and have an annual income at least $75,000, and at least 4 children (22). Personal belief exemptions were found to be more common in areas with higher incomes, as well as higher percentages of whites (20). In fact, in California, whites had the greatest increase in personal belief exemption rates from 2007 to 2013 (20). Using random samples of private kindergartens in California, kindergartens with higher annual tuition (above $10,000) were over twice as likely as schools with lower tuition to have at least 20% of children with personal belief exemptions among the enrolled students (21). Only about half of all the private kindergartens had 95% coverage for measles, mumps, and rubella (MMR) and pertussis-containing vaccines (21).

Several studies also have specifically demonstrated a connection between high exemption rates and private schools. When compared to public schools, private schools have been demonstrated to have higher annual rates of increase in personal belief exemption rates and higher average personal belief exemption rates (7). These areas of high affluence and high exemption may be at higher risk for outbreaks of vaccine-preventable diseases, due to the increasing rates of personal belief exemptions and lack of vaccine coverage. In order to effectively

prevent such outbreaks, it is crucial to have a better understanding of specific community factors that are driving such low rates of vaccine coverage.

Section 3 – Hesitancy among parents & education methods

Personal belief systems influence parents' decisions to vaccinate their children, in addition to community factors previously discussed. Many sociocultural factors have contributed to parents seeking nonmedical exemptions for their children (2, 23-24). Many exemptor parents seek to be more involved in the decision-making process surrounding childhood vaccines, and have a preference for risks that they perceive to be "natural," compared to "man-made" risks (25-26). Parents of exempted children also tend to have low trust of industry and large corporations, having more confidence in alternative medicine professionals and natural products (2, 25, 27-28). Parents of unvaccinated children were four times more likely than parents of vaccinated children to use chiropractors or other alternative medicine services, such as acupuncture (28).

Primarily, parents seeking nonmedical exemptions for their children have strong concerns about possible adverse effects of vaccines, ignited and perpetuated by misreported information and anecdotes (28-30). A case-control study using surveys of parents indicated that the primary reason that parents chose to seek nonmedical exemptions was due to concern that the vaccines might cause harm (28). Commonly refused vaccines include HPV, varicella, and meningococcal conjugate vaccines (28-29). Several studies have attempted to determine characteristics of exemptor parents. A study of Oregon parents found that parents seeking exemptions were more likely to have the following

characteristics, compared with parents vaccinating properly: strong vaccine concerns, "vaccine-hesitant" concerns, more than 1 childbirth at a non-hospital alternative setting, distrust of local doctors, reported chiropractor healthcare for their youngest school-age child, and reported knowledge of someone with a vaccine-hurt child (30). These exemptor parents were also less likely to have "pro-vaccine" beliefs and less likely to rely on print materials in making decisions, compared to vaccinating parents (30). In addition to having concerns about vaccine safety, parents seeking exemptions also refused at least 1 recommended vaccine, and believed that parents should have a right to refuse vaccines required for school entry (29). When compared to vaccinating parents, parents who claimed nonmedical exemptions for their children had lower perceived vaccine efficacy, lower vaccine safety, lower perceived susceptibility to diseases, lower perceived severity of diseases, and low trust in the government (28).

Personal beliefs held by parents can influence the type of education that the parents seek for their children, whether in day-care settings or kindergarten. Personal beliefs that influence the decision to seek nonmedical exemptions may hold sway in the decision on how to best educate their children. So far, the specific education methods that have been examined in association with personal belief exemption trends have been public and private schools. Exemption rates in the United States are significantly higher in private schools than in public schools (4.25% vs. 1.91%, respectively) (31). Private schools also had higher exemption rates for all types of allowed exemptions, including medical, religious, and personal belief exemptions (31). A study of private and public schools in

California from 1994 to 2009 found that the average personal belief exemption rate for private schools was 1.77 times the average rate among public schools (7). This annual rate of increase in personal belief exemptions was also slightly higher among private schools, compared to public schools (10.1% vs. 8.8%) (7). Further delineations of education methods used in private schools have only really been examined at the level of religion. Among a random sample of private schools, the schools with very high personal belief exemption rates (>20%) were the secular, non-Catholic, and Christian schools (21).

There are wide variations in the education methods used in private schools, from religious methods to Waldorf methods. The trend of increasing rates of personal belief exemptions may vary depending on specific education methods of the schools, which may indicate the presence of underlying community factors. The objective of this study was to evaluate trends in personal belief exemption rates for private schools in California that follow specific alternative educational methods, and compare those rates to the personal belief exemption rates for public schools over the course of a 14-year period.

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Chapter II. Manuscript

Title: Trends in Personal Belief Exemption Rates among Alternative Private Schools: Longitudinal Analysis of Waldorf, Montessori, and Holistic Kindergartens in California: 2000-2014.

Authors: Julia M. Brennan, Robert A. Bednarczyk, Jennifer L. Richards, Kristen E. Allen, Gohar J. Warraich, Saad B. Omer

Abstract:

Purpose: Personal belief exemptions to immunization requirements among kindergarteners in the United States have increased in popularity in recent years. The objective of this study was to evaluate trends in personal belief exemption rates for private schools in California that follow alternative educational methods, focusing on Waldorf, Montessori, and holistic education methods.

Methods: We used California Department of Public Health data on personal belief exemptions rates for private and public elementary schools for the 2000-2001 to 2014-2015 school years. Generalized estimating equations were used to model annual average increases in personal belief exemption rates, and to assess whether alternative schools had higher rates of personal belief exemptions.

Results: Over the study period, all alternative schools had an average personal belief rate of 8.7% compared to 2.1% among public schools (incidence rate ratio [IRR]: 3.6, 95% CI:2.9, 4.4). The highest average personal belief exemption rate was observed among Waldorf schools (mean PBE rate = 45.1%), and was 19 times higher than the average public school rate (IRR: 19.1, 95% CI: 16.4, 22.2). The average annual increases in personal belief exemption rates for Montessori schools and holistic schools were slightly higher (Montessori: 8.8%, 95% CI: 6.3-11.4%; Holistic: 7.1%, 95% CI: 4.5-9.7%) than among Waldorf schools (3.6%, 95% CI: 2.6-4.6%). The average annual increase in personal belief exemption rates for public schools was 7.3% (95% CI: 7.0. 7.6%).

Conclusions: Rates of personal belief exemptions among private alternative schools in California were high, and continued to increase across the 2000-2001 to 2014-2015 school years.

Introduction

Rates of nonmedical exemptions to immunization requirements among kindergarteners in the United States have increased in recent years, raising concerns about outbreaks of vaccine-preventable diseases (1-7). In California, parents can obtain nonmedical exemptions to kindergarten immunization requirements for reasons of personal belief and religion (8-9). The rate of personal belief exemptions in California increased from 1.2% to 2.3% from 2004 to 2010 (4). Children with immunization exemptions are clustered geographically and socially, and it is important to examine possible heterogeneity of immunization coverage within states (1, 3, 6, 10). Prior research has shown that rates of personal belief exemptions differ between children enrolled in public and private schools (11-16). For example, the average rate of personal belief exemptions among private schools was found to be nearly double the rate for public schools in California in the last decade (13). There is limited research on more specific community factors that may influence the increasing rates of personal belief exemptions. High socioeconomic status and lower average family size are associated with nonmedical exemptions (6). High personal belief exemption rates are also associated with charter and private schools, schools with high proportions of white students, schools in areas of higher income, schools with low prevalence of free or reduced lunches, schools with higher tuition fees, and schools that follow secular doctrines (9, 11-12, 16).

Personal belief exemption trends may also vary depending on the specific education method of the school, which may indicate the presence of underlying community factors. It is possible that community factors that have been

previously associated with higher personal belief exemption rates (e.g., higher income) may correlate with attendance of a child in a particular school. Exemption trends for specific types of private schools, such as alternative schools, including Waldorf and Montessori schools, have not been investigated previously in the United States. The objective of this study was to evaluate trends in personal belief exemption rates for private schools in California that follow specific alternative educational methods, and compare those rates to the personal belief exemption rates for public schools over the course of a 14-year period.

Methods

We acquired data on personal belief exemption rates for all California public and private schools from the California Department of Public Health (CDPH) for the 2000-2001 through 2014-2015 school years. Data for the earlier years had to be requested from the CDPH, and data for more recent years was publicly available. In the dataset, school-level personal belief exemptions were presented as both counts and rates for each school year. The personal belief exemption rates were reported in the original dataset as the number of enrolled students with personal belief exemptions in that school divided by the total enrollment for that school, specific to each school year. We combined the datasets for each school year into a single dataset for final analysis.

We next classified schools by type (e.g. specific type of private alternative school). The dataset already included a dichotomous variable that categorized the schools as being public or private, which allowed us to search through the private schools to identify and categorize the alternative schools. From a list of schools

contained in the dataset, we searched for each private school's address in an Internet search, and checked the search results with the school name provided in the original dataset. We categorized each private school using two variables, based on information provided by each school's philosophy and mission value statements on website pages. We used a dichotomous variable to designate the school as following an alternative education method (1=alternative, 0=not alternative), and a categorical variable to designated the specific type of alternative method that the school followed. We considered Montessori, Waldorf, and holistic schools in the final analysis. To be categorized as a Montessori or Waldorf school, the school had to claim to follow the Montessori or Waldorf methods or be inspired by these methods on their webpage. The schools that were designated to be holistic schools did not describe an exact education method in their webpages, but did use the phrases "whole child" or "holistic" specifically in philosophy and mission value statements (17). The school categories examined in the analysis were Montessori schools, Waldorf schools, and holistic schools (all considered separately), those three alternative schools combined ("Overall"), all alternative schools combined, and all public schools.

We computed the average personal belief exemption rates across the entire 14-year study period for each school category. We used generalized estimating equations (GEE) based on the negative binomial distribution to estimate incidence rate ratios (IRR) for change in the average PBE rate over the study period, with a cluster term for each school to account for correlated observations. Public and private schools were excluded from analyses if the school as missing personal belief exemption rate data for that year (n=1,367); schools with data

missing only for some years were retained for the years in which exemption rate data were present. The specific schools in each school category could vary by year. Therefore, the exact same schools did not have to be represented in every year of data across the 14-year period to be included in the analysis. First, we modeled the average annual increase in personal belief exemption rate across all alternative schools and across all public schools. Second, we stratified the analyses by alternative school type, using Montessori schools, Waldorf schools, holistic schools, and a category of these three school types combined ("Overall"). Estimated IRRs were interpreted as average annual increases in personal belief exemption rates from incidence rate ratios; for example, an IRR of 1.073 (95% CI: 1.070, 1.076) would translate into an average annual increase in the personal belief exemption rate of 7.3% (95% CI: 7.0%, 7.6%). Third, we estimated IRRs comparing the average personal belief exemption rates between all school category types and the public schools. All analyses were unadjusted for potential confounders, due to the limited covariate data available. Demographic data was not available in this dataset, other than county and city location of each school. We performed all statistical analyses using SAS v9.4 (Cary, NC).

We obtained the data in different stages from the California Department of Public Health. The California Committee for the Protection of Human Subjects (CPHS) approved the use of non-publicly available data. d. The Emory University Institutional Review Board and the California Institutional Review Board also approved the use of the data for this study.

Results

Alternative and public schools contributed 84,227 school-years of data across the 14-year period (Table 1). A total of 6,656 public schools contributed 81,002 school-years of data. Additionally, 147 Montessori schools, 20 Waldorf schools, and 35 holistic schools contributed a total of 2,413 school-years of data.

The Waldorf schools had the highest average personal belief exemption rate of 45.1% across the study period (Table 2). The holistic schools had the second-highest personal belief exemption rate of 7.4%. Among the alternative schools analyzed, the Montessori schools had the lowest average personal belief exemption rate at 3.9% across the study period. Public schools had the lowest average personal belief exemption rate of 2.1% across the study period.

The average personal belief exemption rate for public schools increased from 0.9% during the 2000-2001 school year to 2.8% during the 2014-2015 school year, an average annual increase of 7.3% (95% CI: 7.0%, 7.6%) (Table 2, Fig. 1). In comparison, the average personal belief exemption rate increased from 5.1% to 10.8% for all alternative schools in the 14-year period, an average annual increase of 7.5% (95% CI: 4.3%, 6.7%) (Table 2, Fig. 1). Among the alternative schools, the average personal belief exemption rate for Montessori schools increased from 2.2% to 4.4% across the study period, an average annual increase of 8.8% (95% CI: 6.3%, 11.4%). The average personal belief exemption rate for holistic schools increased from 3.9% to 11.2% in the 14-year period, an average annual increase of 7.1% (95% CI: 4.5%, 9.7%). The average personal belief exemption rate for Waldorf schools increased from 30.3% to 48.2% across the study period, an average annual increase of 3.6% (95% CI: 2.6%, 4.6%).

The personal belief exemption rate among Waldorf schools was 19 times higher than the rate for public schools (IRR: 19.1, 95% CI: 16.4, 22.2) (Table 2). The next highest personal belief exemption rate, compared to public schools, was among the holistic schools (IRR: 3.0, 95% CI: 2.2, 4.2). The personal belief exemption rate among Montessori schools was slightly higher than the rate for public schools (IRR: 1.6, 95% CI: 1.3, 2.0). Overall, these types of alternative schools had personal belief exemption rates that were almost 4 times higher than public schools (IRR: 3.9, 95% CI: 3.1, 4.9). When all alternative schools were compared to public schools, the personal belief exemption rates were 3.6 times higher than the rates for public schools (95% CI: 2.9, 4.4).

The Waldorf schools had the highest rate of personal belief exemptions compared to the public schools (IRR: 19.1 (95% CI: 16.3, 22.1), but the Waldorf schools had the lowest annual change in average personal belief exemption rate (3.6%, 95% CI: 2.6%, 4.6%) (Table 2). The Waldorf schools had by far the highest baseline personal belief exemption rate across all school types included in the final analysis, with an average personal belief exemption rate of 45.1%. The next highest average personal belief exemption rate is 7.4%, for the holistic schools. The Montessori schools have a similarly lower average personal belief exemption rate of 3.9%.

Discussion

This study examined the trends in rates of personal belief exemptions to kindergarten immunization requirements among private alternative schools, using a comprehensive dataset including California schools from 2000 through

2014. Overall, the personal belief exemption rates increased across all alternative school types considered in the analysis, as well as among the public schools. The average rate of increase varied by type of alternative educational method. These findings demonstrate a need to target policies and educational efforts to parents of children within these private alternative schools, specifically among Waldorf schools. Our findings provide evidence that can be used in addressing the increasing rates of personal belief exemption in states that still allow personal belief exemptions, with legislation and intervention programs targeting parents that are seeking alternative schools for their children.

Based on the results of this analysis, concerns should be raised about both the high overall rate of personal belief exemptions among Waldorf schools and the high rate of annual change in the other alternative schools. The overall rate of personal belief exemptions for Waldorf schools over the study period is alarmingly high (45.1%), and that rate is still climbing, even if at a lower rate than the other alternative schools. The baseline rates of personal belief exemptions for holistic and Montessori schools are lower, with average personal belief exemption rates of 7.4% and 3.9%, respectively. However, it is still critical to target these schools because the annual change in personal belief exemption rates among these schools is the highest among the alternative schools.

These findings provide evidence of heterogeneous trends in personal belief exemption among private alternative schools, beyond the delineation between public and private schools, previously described (11-16). Even though the Waldorf schools had the highest rate of exemption compared to public schools, the Waldorf schools had the lowest annual change in exemption rates among the

alternative schools. The Montessori schools had the highest annual change in average personal belief exemption rate. Smaller sample sizes for some of the alternative school categories could have affected the wider confidence intervals present in the results, particularly for Waldorf schools. It is also important to note that, even with these high exemption rates, the alternative schools that we analyzed were a smaller subset of the overall student population in California.

Our findings suggest that not only are personal belief exemption rates higher on average among private alternative schools, but they are also increasing faster among specific types of alternative schools. There may be important distinguishing characteristics of the populations attending these different private alternative schools. Parents seeking vaccine exemptions for their children are more likely to seek alternative non-hospital childbirth settings, seek chiropractic healthcare for their children, distrust medical doctors, and to be less likely to use print materials compared with vaccinating parents (18). Parents of children at a well-established U.S. Waldorf school were highly educated and involved in health decisions for their children, and overwhelmingly viewed vaccination of children to be unnecessary, toxic, developmentally inappropriate, and profit-driven (19). Vaccine refusal among these parents after enrollment increased in the school, implying a socially cultivated reinforcement of vaccine refusal in Waldorf school settings, with special emphasis on seeking alternative education and life choices (19). Further investigation is needed to develop appropriate interventions addressing vaccine refusal for these groups of parents that enroll their children in alternative education schools.

A major strength of this study was that we were able to obtain and analyze data from a 14-year period, including most recently data from the 2014-2015 school year. Another strength of the study is the robust method used to categorize private schools by educational method (i.e., online search by school address an review of school websites). These methods captured all of the alternative schools in the available dataset, rather than only using the data for alternative schools present on unofficial online lists. It is possible that a certain level of misclassification could have been introduced through the potentially subjective nature of how the holistic schools were categorized. Additionally, our study did not include census tract-level data in the analysis, as previous articles have noted the potential issue that census tract data may not accurately reflect the data for students that attend private schools (3). Our objective was to describe trends across alternative school types compared to public schools; therefore, our analyses were not adjusted for potential confounders (e.g., census tract-level data).

Personal belief exemptions to school immunization requirements will soon be restricted in California after the passage of SB 277 in June 2015 (8). After the law comes into effect in July 2016, only homeschooled children in California will be allowed non-medical exemptions to immunization requirements, and children without a medical exemption will be required to have up-to-date vaccines. The new law applies to both public and private elementary schools, secondary schools, and daycare centers. As a result, trends in personal belief exemption rates in California will change, and possible trends should be investigated in the future. It will be important to investigate the implementation of this new law, as

well as the potential for variability in local enforcement and ease of obtaining the new exemption for homeschooled children (20).

However, the results of this analysis will also be useful elsewhere in the United States, where alternative education methods are also popular. Waldorf, Montessori and holistic education methods are not unique to the state of California. Our findings demonstrating increasing rates of personal belief exemptions and heterogeneity among private alternative schools in California may likely reflect national trends. It is important to understand underlying community factors when attempting to develop and maximize the efficacy of interventions aimed at addressing vaccine refusal. Control of vaccine-preventable diseases requires "indefinite maintenance of extremely high rates of timely vaccination," and it is critical to tailor messages for parents with vaccine concerns as precisely as possible (20). Based on the results of this study, potential interventions should be aimed at specific types of private alternative schools and the populations that support them, with the awareness that the average rate of increase in personal belief exemption rates and the average personal belief exemption rate could vary by type of alternative education method.

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Tables

Table 1. Sample Sizes by Year for Different School Types Considered in the Final Analysis, California, 2000-2014.

	School Type					
School Years	Public	All Alternative	Overall Alternative*	Montessori	Waldorf	Holistic
2000	5,092	231	173	124	18	31
2001	5,172	235	180	126	20	34
2002	5,203	233	178	128	19	31
2003	5,251	225	170	118	19	33
2004	5,286	227	170	121	18	31
2005	5,364	228	173	122	20	31
2006	5,423	229	171	123	18	30
2007	5,440	222	164	113	19	32
2008	5,443	226	173	123	19	31
2009	5,443	227	171	121	19	31
2010	5,507	209	155	103	20	32
2011	5,572	205	153	108	20	25
2012	5,578	204	151	102	20	29
2013	5,584	168	118	73	18	27
2014	5,644	156	113	74	15	24
Total	81,002	3,225	2,413	1,679	282	452

*Overall Alternative = Waldorf, Montessori, Holistic schools combined

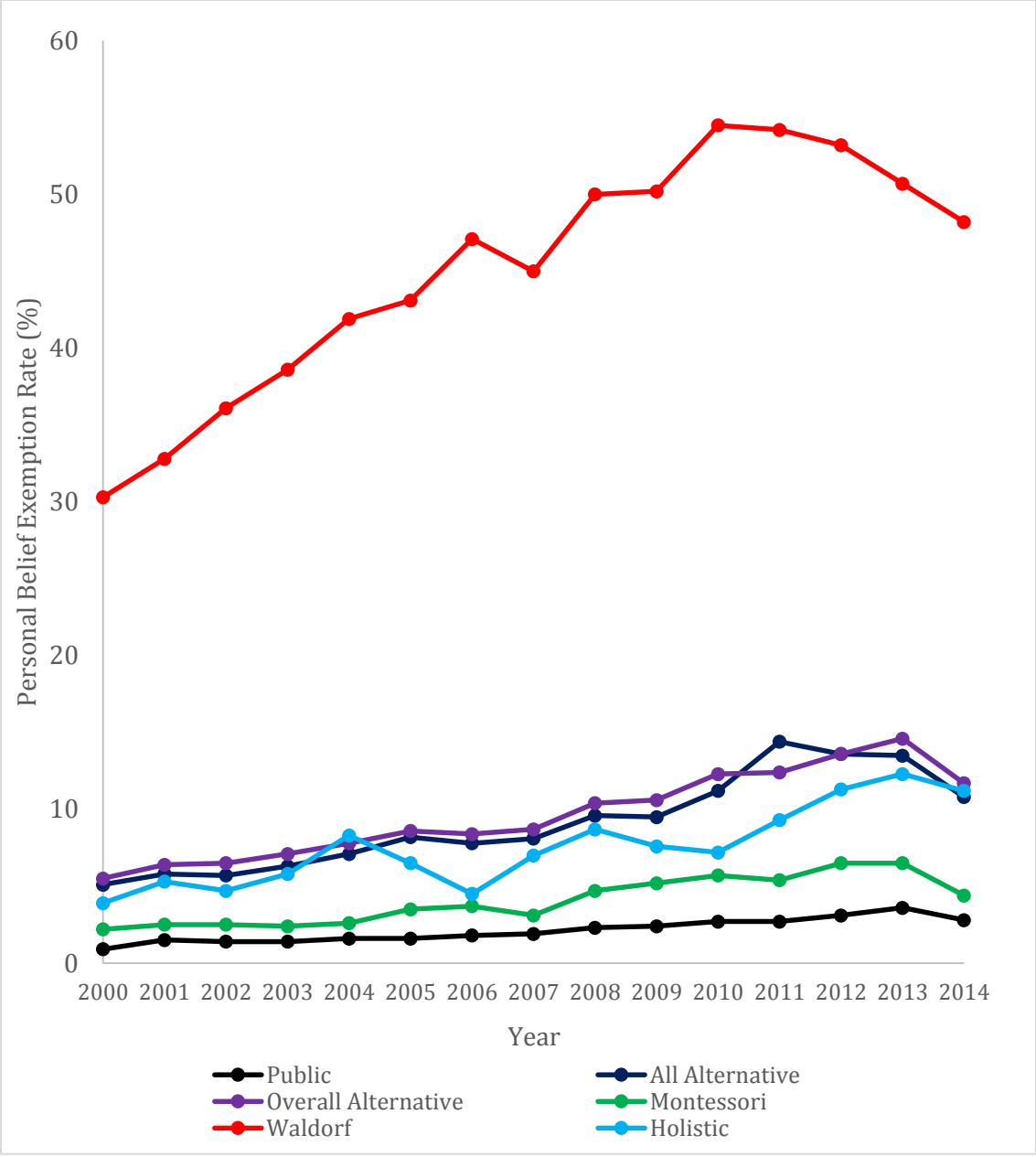
Table 2. Personal Belief Exemption Rates, Stratified by School Type, California, 2000-2014.

School Type	School -Years (N)	Average Personal Belief Exemption Rate (%)	Annual % Change in Average Personal Belief Exemption Rate (95% CI)	Incidence Rate Ratio (95% CI)
Public	81,002	2.1	7.3 (7.0, 7.6)	*Reference*
All Alternative	3,225	8.7	7.5 (4.2, 10.9)	3.6 (2.9, 4.4)
Overall Alternative*	2,413	9.4	5.5 (4.2, 6.8)	3.9 (3.1, 4.8)
Waldorf	282	45.1	3.6 (2.6, 4.6)	19.1 (16.4, 22.2)
Holistic	452	7.4	7.1 (4.5, 9.7)	3.0 (2.2, 4.2)
Montessori	1,679	3.9	8.8 (6.3, 11.4)	1.6 (1.3, 2.0)

*Overall Alternative = Waldorf, Montessori, Holistic schools combined

Figures

Figure 1. Average Personal Belief Exemption Rates by School Type, California, 2000-2014.



Chapter III. Summary & Public Health Implications

Based on this analysis, rates of personal belief exemptions among private alternative schools in California were high, and continued to increase across the 2000-2001 to 2014-2015 school years. As previously discussed, the average annual increase in personal belief exemption rates, as well as the average overall personal belief exemption rates, varied for the Waldorf, Montessori, and holistic schools over the 14 years. The Waldorf schools had the highest rate of personal belief exemptions compared to the public schools, but the Waldorf schools had the lowest annual change in average personal belief exemption rate. The Waldorf schools had by far the highest overall personal belief exemption rate across all school types included in the final analysis, with an average personal belief exemption rate of 45.1%. The next highest average personal belief exemption rate is 7.4%, for the holistic schools. The Montessori schools have a similarly lower average personal belief exemption rate of 3.9%. These results provide evidence of the heterogeneous nature of which parents are seeking personal belief exemptions for their children among private alternative schools. The complexity of differing rates of immunization exemptions clearly extends beyond the simpler delineation between public and private schools.

For interventions and public health education to effectively address the issue of increasing exemptions to childhood vaccinations, it will be absolutely crucial to have as much information as possible about the target population of such interventions, including knowledge of community factors and beliefs that may influence a parent to seek an exemption for their child. Based on the results

of this study, it would be a fair proposal to focus on the selection and design of intervention programs to target parents of children who attend Waldorf schools. Such targeted information can be extremely useful to most effectively and efficiently reduce immunization exemptions and increase immunization coverage in these specific communities that are at an increased risk of acquiring and spreading vaccine-preventable diseases. Our findings demonstrating increasing rates of personal belief exemptions and heterogeneity among private alternative schools in California may likely reflect national trends. As previously discussed, it is critical to tailor messages for parents with vaccine-related concerns as precisely as possible. Based on the results of this study, potential interventions should be aimed at specific types of private alternative schools and the populations that support them, with the awareness that the average rate of increase in personal belief exemption rates and the average personal belief exemption rate could vary by type of alternative education method.

Future Research

In order to wholly understand the situation surrounding personal belief exemptions in these schools, it would be beneficial in the future to have a more quantitative and informed concept of the factors driving these parent populations seeking exemptions in the first place. Potential trends should also be examined in other states and communities, to determine how far this trend extends in the United States. Within California, it will be beneficial to expand our knowledge of the local implementation of restrictions on personal belief exemptions after the passage of SB 277 in June 2015.

Final Page of Thesis Document

Trends in Personal Belief Exemption Rates among Alternative Private Schools: Longitudinal Analysis of Waldorf, Montessori, and Holistic Kindergartens in California: 2000-2014.

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