



# Affluence as a predictor of vaccine refusal and underimmunization in California private kindergartens



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## ABSTRACT

**Background:** Non-medical vaccine exemption rates in California private schools far exceed those of public schools, but little is known about specific factors which may be associated with high exemption rates in private schools.

**Methods:** The percent of personal-belief exemptions (PBEs) among California public and private kindergartens were computed for 2000–2001 to 2014–2015 academic years. For the 2014–2015 academic year, a random sample of private schools was selected to investigate associations between kindergarten characteristics (tuition amount, religious affiliation) and vaccine profile (non-medical vaccine exemptions, vaccine coverage).

**Results:** The proportion of private kindergartens reporting 5% or more children with PBEs increased from 9% (2000–2001) to 34% (2013–2014), followed by a small decrease in 2014–2015 (31%). Overall, 93.7% (565/605) of kindergartens sampled in 2014–2015 had data available. Very high PBE levels (>20%) were seen among secular and non-Catholic, Christian kindergartens but not Roman Catholic, Jewish or Islamic kindergartens. However, the majority of schools at all tuition levels had fewer than 5% of children with a PBE. Kindergartens with an annual tuition of \$10,000 or more were over twice as likely to have 20% or more children with PBEs than kindergartens with a lower tuition ( $p < .01$ ). Additionally, the conditional admission proportions for kindergartens with tuitions of \$10,000 or more were 39% compared to 22% for less expensive kindergartens ( $p < .01$ ). Only about half of all private kindergartens had 95% coverage of the MMR (49%) and pertussis-containing vaccines (51%).

**Conclusions:** School-entry vaccination requirements are critical to preventing outbreaks of vaccine preventable diseases in the US. Nonmedical exemptions increased between the 2000–2001 and 2014–2015 academic years and appear to be associated with affluence, raising social justice concerns.

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## 1. Introduction

Vaccines save lives and prevent substantial disability [1]. Central to maintaining effective vaccination coverage in the United States have been state laws requiring school age children attending public,

and in most states private, schools to be vaccinated [2]. However, variations in state mandates and school enforcement have created disparities in vaccination coverage. As of October 2015, all states allow exemptions to school immunization requirements for medical contraindications, 48 states allow religious exemptions, and 20 states allow philosophical or personal belief exemptions (PBEs) [3]. On January 1, 2016, California will join West Virginia and Mississippi as the three states that *only* permit medical exemptions [4,5]. Evidence is accumulating that states with less stringent requirements for granting exemptions tend to experience a resurgence of vaccine-preventable diseases [6–8].

Children in US private schools are more likely to have received an exemption to one or more required immunizations, and

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exemption rates in private schools are increasing [9–13]. However, the complex matrix of factors driving vaccine exemptions among private school enrollees is difficult to quantify. Families send their children to private schools for reasons that include religious beliefs, improved quality of education (e.g., smaller student:teacher ratio), and desire for a more highly controlled environment (e.g., curriculum content, school community) [14]. While religious beliefs may play a role in the vaccination decision for some faith communities, no major religion officially opposes vaccination [15]. Some faith groups have been consistently reluctant to vaccinate, however, a recent study suggests that the primary concerns contributing to under-vaccination are more closely aligned with concerns about adverse effects than faith beliefs [16]. Therefore, it is unclear whether the increasing non-medical exemption rates in private schools are motivated by religious beliefs or other potentially modifiable factors.

Affluence has also been associated with vaccine exemptions. Private schools are costly compared to free public education, and families who enroll their children in private schools, particularly those without a religious affiliation, tend to have higher incomes [17]. Thus, it is possible that the key driver of nonmedical exemptions in private schools is related to socioeconomic status (SES) rather than religious beliefs. Indeed, prior research has found parents with a college education or higher SES were more reluctant to adhere to the recommended vaccine schedule [18].

Unfortunately, census data is not available for private schools due to the geographically scattered residences of students and thus undefined catchment areas. Furthermore, private schools generally do not share matriculated families' financial information. However, annual tuition costs are often available, and may serve as an indirect indicator of the average family's SES.

To begin describing the relationships between religion, affluence and nonmedical exemptions in private schools, we assessed whether any associations exist between (1) school type and PBEs, and (2) tuition and PBEs. We hypothesized that schools with higher tuitions would be more likely to report a greater percent of non-medical exemptions. Understanding what motivates non-medical exemptions will inform efforts to address vaccine hesitancy and inform the ongoing social fairness dialogue concerning those now bearing a disproportionate burden of establishing herd immunity.

## 2. Methods

The state of California permits medical exemptions and, until 2016, PBEs to immunization requirements for school entry. A PBE exemption request may be accepted if parents or guardians hold genuine beliefs that conflict with the practice of immunization, regardless of membership in an established religious organization [3]. Prior to 2013, a parent or guardian was required to complete a PBE request form to be reviewed by a school administrator. Starting in 2014, parents were required to have this form signed by a health care professional who provided education on vaccines.

Publicly available data from the annual School Immunization Survey were obtained from the California Department of Public Health (CDPH). Kindergartens with 10 or more students are required to report immunization-related data. To assess trends in PBEs for both public and private schools, 15 academic years were analyzed (2000–2001 to 2014–2015). Separately for public and private schools, we calculated school-specific proportions of kindergarteners with PBEs and categorized the schools as follows: <1% exempt, 1–4.9%, 5–9.9%, and 10+%. School-specific vaccine coverage >95% was computed for each required vaccine (i.e., 2 doses of measles, mumps and rubella vaccine (MMR), 4 doses of pertussis containing vaccines (e.g., DTaP), 3 doses of polio vaccine, 3 doses of hepatitis B virus (HBV) vaccine and at least 1 dose of varicella

vaccine) and up-to-date status (i.e., all required doses of all required vaccines).

To study the association between tuition, religious affiliation and vaccine measures, we focused on the 2014–2015 academic year. Publicly available data includes basic information about the school (name, location, ID code), type of school (public or private), enrollment in kindergarten, and vaccine-related information. Vaccine data includes exemption numbers and percentages (medical, PBE), and the number and percent of children with documentation of each required vaccine and overall up-to-date status. Additionally, schools report the number and percent of students who are enrolled under a 'conditional admission' status, meaning they are actively in the process of receiving required vaccines.

A simple random sample of all private schools in California was selected. Schools serving only special needs children were excluded because public funds often pay for the tuition. Schools designed to support home schooling were also excluded. For each randomly selected kindergarten, research assistants reviewed the school's website for religious affiliation and annual tuition; if not found, information was solicited by telephone. The research assistants were blinded to kindergarten vaccine data.

Religious affiliation was recorded and subsequently categorized as secular, Christian (Roman Catholic, other), Islamic, or Jewish. Christian schools included Christian denominations other than Roman Catholic, as follows: nondenominational Christian, Baptist, Episcopal, Lutheran, Methodist, and Seventh Day Adventist. Secular schools were noted as Waldorf or Montessori, when appropriate. Waldorf schools follow Rudolph Steiner's teaching on Anthroposophy which expressly stated concerns with vaccines and much of modern medicine [19].

Tuition for kindergarten was recorded. When the option of full- or half-day kindergarten was available, we recorded the full-day tuition. We recorded any discounts for students who belong to the church (e.g., parish). Differences between parish and non-parish tuition were not substantial, thus we used non-parish tuition for analyses. In schools that offered discounts for multiple family members, tuition for the first child enrolled was used.

We used SAS<sup>®</sup> for data management and statistical analyses. Comparison of PBE proportions reported by public and private schools were assessed using logistic regression, solved using generalized estimating equations to adjust for repeated measures (i.e., schools could be included up to 15 times).

Religious affiliation and tuition data for schools were merged with vaccine data obtained from the CDPH. We conducted bivariate analyses between tuition amount and religion with (1) PBE, (2) coverage of each vaccine, (3) proportion of up-to-date status, and (4) proportion of conditional status. Stratified analyses were conducted to assess the association between each exposure factor (tuition amount and religion) with PBE, controlling for the other factor. Logistic regression was conducted to statistically determine if each factor was associated with PBEs, after adjustment for the other factors studied.

Because this study only used school-level data available to the public, the University at Albany Institutional Review Board did not review the study.

## 3. Results

The number of private kindergartens reporting vaccination data in California decreased from 2326 in the 2000–2001 academic year to 1388 in the 2014–2015 academic year while the number of public kindergartens reporting vaccination data increased from 5092 to 5644 for the same academic years. The proportion of both private and public kindergartens reporting high levels of PBEs increased until 2013–2014, followed by a small decrease in 2014–2015. For example, private kindergartens reporting 5% or

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