

Introduction

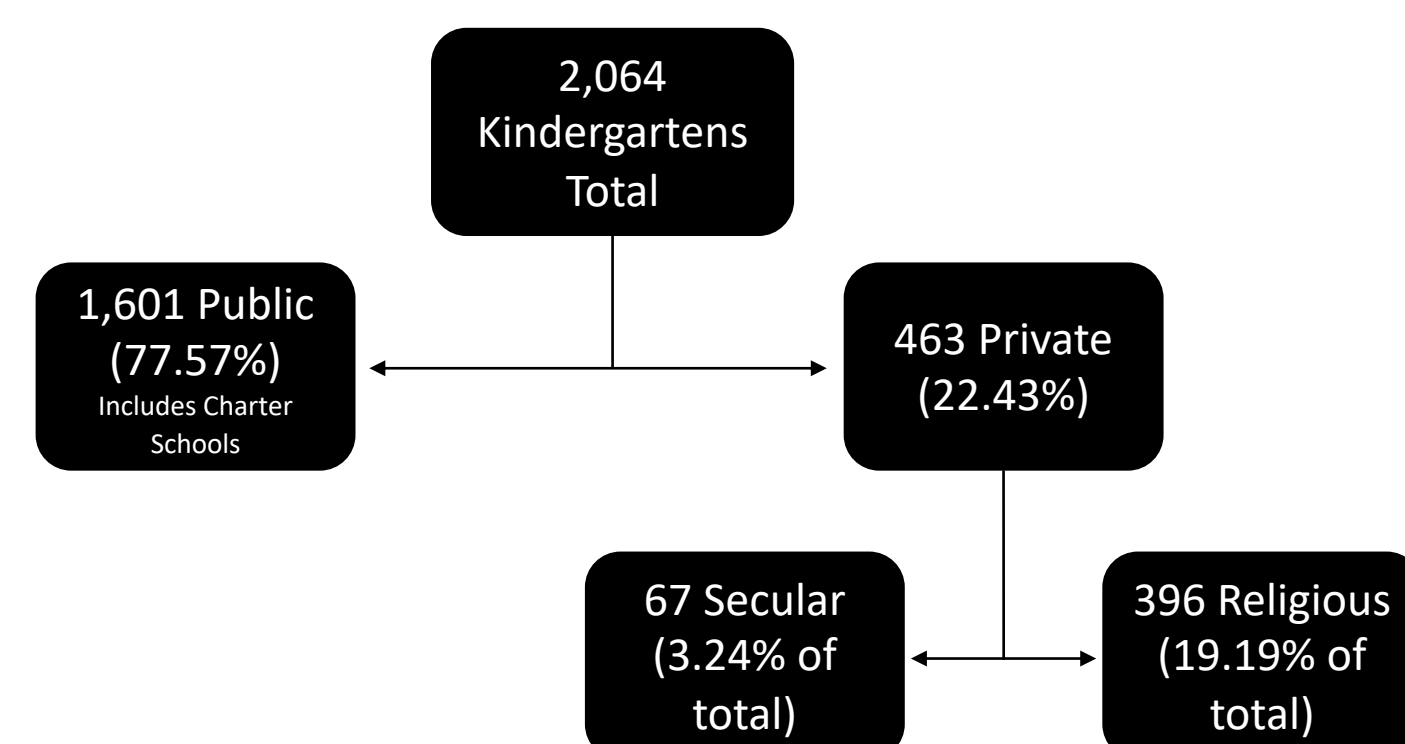
Religious community membership is relevant to immunization policy, as in the case of 2019 US measles outbreaks clustered in Orthodox Jewish communities. US immunization policy focuses on school enrollment requirements, which apply both to public and private (usually religiously-affiliated) schools. Most US states exempt students from these requirements for nonmedical reasons, including religious reasons, though some states, including New York, California, and Maine, have recently eliminated nonmedical exemptions.

Aims and Objectives

This study uses 2017-18 data from the state of Michigan to illuminate relationships between nonmedical exemption (NME) rates and attendance at religious schools with the aim of providing information about high-value targets for future vaccination policy to increase compliance and decrease vaccine-preventable diseases.

Methods

- Utilized 2017-18 school year data from
 - Michigan department of health and human services
 - Michigan center for Educational Performance and Information
 - American Community Survey from the US Census Bureau
- Total sample of 2,064 kindergartens and 118,670 individuals
- Demographic analysis
- Comparison of prevalence of NME between institution types
- Cohort comparison
- Sample Composition



Results

Demographic Analysis

Demographic Correlations of NME Rates by County

Positive/Direct Correlation	P-Value	Negative/Inverse Correlation:	P-Value
Higher Bachelor Degree rate	0.0101	Higher poverty rate	0.0001
Higher private insurance coverage	0.0001	Higher public insurance coverage	0.0033
Higher household median income	0.0001	Higher uninsured rate	0.0019
Higher family median income	0.0001	Higher Black/African American population	0.0030
Higher computing device ownership	0.0028	Higher Hispanic population	0.0012
Higher desktop/laptop ownership	0.0001		
Higher tablet/portable ownership	0.0185		

Comparison of NME Prevalence

- Religious kindergartens were 43% less like to enroll any students with NMEs compared to public kindergartens (OR: 0.57, p>0.001)
 - 32% less likely to have students with religious exemptions (OR: 0.68, p=0.0019)
 - 47% less likely to have students with personal belief exemptions (OR: 0.53, p<0.001)

Exemption Type

	Kindergartens With At Least One Religious NME	Kindergartens With At Least One Philosophical NME
Public Kindergartens Possessing At least One NME	548/1,170 = 46.84%	1,056/1,170 = 90.26%
Religious Private Kindergartens Possessing At Least One NME	103/240 = 42.92%	201/240 = 83.75%

Cohort Size

	Public	Religious Private
Class Size	64* (IQR 45-85)	14* (IQR 9-26)
Total School Size	839*	156*

*Median Values

*Mean Values

- Larger cohorts mean more contact opportunities and thus more chances for transmission
- Spread of vaccine preventable diseases is dependent on clustering of vulnerable individuals

Conclusions

- Wealth, non-minority status, and access to internet devices are positively correlated with NMEs
- Public schools are more likely to enroll students with NMEs – decreased fear over private schools being a nidus for outbreak
- Public schools tend to have larger cohorts
 - Outbreak risk is based on *clustering* of unvaccinated individuals

References

- Quinn SC, Jamison AM, Freimuth VS. Measles outbreaks and public attitudes towards vaccine exemptions: some cautions and strategies for addressing vaccine hesitancy. *Hum Vaccin Immunother*. 2019. doi:10.1080/21645515.2019.1646578
- Goldstein ND, Purdie J, Suder JS. Association between vaccine refusal and vaccine-preventable diseases in the United States: A review of measles and pertussis. *JAMA Pediatr*. 2020;174(1):88-89. doi:10.1001/jamapediatrics.2019.4365
- Bell BP, Romero JR, Lee GM. Scientific and Ethical Principles Underlying Recommendations From the Advisory Committee on Immunization Practices for COVID-19 Vaccination Implementation. *JAMA*. 2020;324(20):2025-2026. doi:10.1001/jama.2020.20847
- Birnbaum MS, Jacobs ET, Raiston-King J, Ernst KC. Correlates of high vaccination exemption rates among kindergartens. *Vaccine*. 2013;31(5):750-756. doi:10.1016/j.vaccine.2012.11.092
- Office for State Tribal Local and Territorial Support. State School Immunization Requirements and Vaccine Exemption Laws. 2017. <https://www.cdc.gov/php/docs/school-vaccinations.pdf>.
- States With Religious and Philosophical Exemptions From School Immunization Requirements. National Conference of State Legislatures. <http://www.ncsl.org/research/health/school-immunization-exemption-state-laws.aspx>. Published 2022.
- Grabenstein JD. What the World's religions teach, applied to vaccines and immune globulins. *Vaccine*. 2013;31(16):2011-2023. doi:10.1016/j.vaccine.2013.02.026
- Bednarczyk RA, King AR, Lahjani A, Omer SB. Current landscape of nonmedical vaccination exemptions in the United States: impact of policy changes. *Expert Rev Vaccines*. 2019;18(2):175-190. doi:10.1080/14760584.2019.1562344
- Cadena J, Falcone D, Marathe A, D'Souza A, Vulliamy J, A. *Disco*
- using network scan statistics. *BMC Med Inform Decis Mak*. 2019;19(1):1-14. doi:10.1186/s12911-018-0706-7
- Private School Universe Survey, Number and Percentage Distribution of Students in Private Schools, by Religious Orientation, Community Type, and Race/Ethnicity: 1993-94 through 2005-06. 2016.
- Michigan Center for Education Performance and Information. Educational Entity Master. <https://oeipi.state.mi.us/eem/>. Accessed April 12, 2019.
- United States Census Bureau. American Community Survey. <https://www.census.gov/programs-surveys/acs>. Accessed April 12, 2019.
- MI School Data. MDE Home School Data. Nonpublic Student Counts.
- Glasser JW, Feng Z, Omer SB, Smith PJ, Rodewald LE. The effect of heterogeneity in uptake of the measles, mumps, and rubella vaccine on the potential for outbreaks of measles: A modelling study. *Lancet Infect Dis*. 2016;16(5):599-605. doi:10.1016/S1473-3099(16)00004-9
- Fields VS, Saifi H, Waters C, et al. Mumps in a highly vaccinated Marshalllese community in Arkansas, USA: an outbreak report. *Lancet Infect Dis*. 2019;19(2):185-192. doi:10.1016/S1473-3099(18)30607-8
- Division of Viral Diseases. Transmission of Measles. Center for Disease Control and Prevention. <https://www.cdc.gov/measles/transmission.html>. Published 2018. Accessed June 12, 2019.
- MI School Data. MDE Nonpublic School Data. Nonpublic Student Counts. <https://www.mischooldata.org/historical-nonpublic-student-counts/>. Published 2017.
- MI School Data. Student Enrollment Counts Report. <https://www.mischooldata.org/student-enrollment-counts-report/>.
- Smith N, Graham T. Mapping the anti-vaccination movement on Facebook. *Inf Commun Soc*.
- 2017;22(9):1310-1327. doi:10.1080/1369118X.2017.1418406
- King AR, Salmon KS, Bednarczyk RA. Understanding the impact of state vaccination laws on exemption rates. *Curr Opin Pediatr*. 2020;31(1):160-166. doi:10.1097/MOP.0000000000000844
- Wilson SE, Murray J, Bunko A, et al. Characteristics of immunized and un-immunized students, including non-medical exemptions, in Ontario, Canada: 2016-2017 school year. *Vaccine*. 2019;37(23):3123-3132. doi:10.1016/j.vaccine.2019.04.033
- Delamater PL, Leslie TF, Yang YT, Jacobsen KH. An approach for estimating vaccination coverage for communities using school-level data and population mobility information. *Appl Geogr*. 2016;71:123-132. doi:10.1016/j.apgeog.2016.04.008

Acknowledgements

OUWB Embark Program Directors
My mentor Dr. Navin
Michigan Department Health and Human Services
Michigan's Center for Educational Performance and Information