TITLE

Relationship Between the Use of Nonpharmaceutical Interventions and COVID-19 Vaccination Among U.S. Child Care Providers: A Prospective Cohort Study

SHORT TITLE

Nonpharmaceutical Interventions & COVID-19 Vaccination in Child Care

AUTHORS

Kavin M. Patel, MD[a]; Mehr Shafiq, MPH[b,c]; Amyn A. Malik, MBBS, MPH, PhD[a,b]; Ayse Cobanoglu, PhD[d]; Madeline Klotz, BA[e]; John Eric Humphries, PhD[f]; Aiden Lee[f]; Thomas Murray, MD, PhD[g]; David Wilkinson, JD[f,h]; Inci Yildirim, MD, PhD, MSc[b,g,h]; Jad A. Elharake, MPH[a,b]; Rachel Diaz, BA[h]; Rosalia Rojas, BA[d]; Anael Kuperwajs Cohen, BA[d]; Chin R. Reyes, PhD[d]; Saad B. Omer, MBBS, MPH, PhD[a,b,j,k]; Walter S. Gilliam, PhD[d]

AFFILIATIONS

[a]Yale School of Medicine, New Haven, CT; [b]Yale Institute for Global Health, New Haven, CT; [c]Mailman School of Public Health, Columbia University, New York, NY; [d]Yale Child Study Center, Yale School of Medicine, New Haven, CT; [e]Human Development and Family Studies, Michigan State University, East Lansing, Michigan; [f]Department of Economics, Yale University, New Haven, CT; [g]Department of Pediatrics, Yale School of Medicine, New Haven, CT; [h]Tobin Center for Economic Policy, Yale University, New Haven, CT; [h]Department of Epidemiology of Microbial Diseases, Yale School of Public Health, New Haven, CT; [j]Yale School of Public Health, New Haven, CT; [k]Yale School of Nursing, New Haven, CT

CORRESPONDING AUTHOR

Walter S. Gilliam, Yale Child Study Center, Yale School of Medicine, 310 Prospect Street, New Haven CT 06511, walter.gilliam@yale.edu, 203-432-4575.

CONTRIBUTORS' STATEMENT PAGE

Dr. Patel designed the study, conducted the literature search, contributed to data interpretation, and drafted the initial manuscript. Dr. Malik designed the study, conducted the literature search, analyzed data, contributed to data interpretation, and contributed to revision of the manuscript. Ms. Shafiq, Dr. Cobanoglu, Mr. Lee helped to organize and analyze data, contributed to data interpretation, and contributed to critical revision of the manuscript. Dr. Yildirim, Dr. Chin, Mr. Elharake, Mr. Wilkinson, Ms. Rojas, Ms. Kuperwajs Cohen, and Ms. Diaz contributed to data interpretation and contributed to critical revision of the manuscript. Ms. Klotz led data acquisition and development of the online survey tool, analyzed data, contributed to data interpretation, and contributed to critical revision of the manuscript. Profs. Humphries and Murray designed the study and contributed to data interpretation, and contributed to critical revision of the manuscript. Prof. Omer designed the study, contributed to the analytic approach, contributed to data interpretation, and contributed to critical revision of the manuscript. Prof. Gilliam is the senior author who conceptualized the study, designed the study, conducted the literature search, was involved in aspects of data collection and analysis, and contributed to critical revision of the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work. **All authors attest they meet the ICMJE criteria for authorship.**

ACKNOWLEDGEMENTS

Invaluable assistance with obtaining child care provider contact information was provided by the National Workforce Registry Alliance (and its network of state child care workforce registries), Child Care

Aware of America, and National Association for the Education of Young Children. Drs. Amalia Londono Tobon and Adrián Cerezo Caballero provided Spanish translations and back translations of the survey measures and recruitment information.

DISCLOSURES
All authors report no conflicts of interest.

FUNDING
All phases of this study were supported by the Andrew & Julie Klingenstein Family Fund, Esther A. & Joseph Klingenstein Fund, Heising-Simons Foundation, W.K. Kellogg Foundation, Foundation for Child Development, Early Educator Investment Collaborative, Scholastic Inc, Yale Institute for Global Health, and Tobin Center for Economic Policy at Yale University. Dr. Patel is supported by the National Institute of Health.

ROLE OF FUNDER
The funders/sponsors did not participate in the work.

WORD COUNT
2817

TABLES/FIGURES
3

I. INTRODUCTION

On August 23, 2021, the United States (U.S.) Food and Drug Administration approved the first vaccine against the coronavirus disease 2019 (COVID-19).[1] The move reinvigorated public discourse about the role of compulsory vaccination in achieving pandemic control in congregate settings.[2] Child care programs are unique among other congregate settings in that most of the inhabitants are under the age of 5, and, as such, remain ineligible for vaccination and may also have a more challenging time adhering to nonpharmaceutical interventions.[3] In recognition of the disproportionate risk of infection within child care programs from the congregation of unvaccinated and unmasked infants and children—particularly in the wake of highly transmissible variants of concern—state[4] and federal[5] lawmakers have begun to mandate COVID-19 vaccination among child care providers.

As state and federal vaccine mandates for child care providers begin to roll out, legal challenges are to be expected. Litigation grounded in constitutional, administrative, and/or common law among others may soon be, or are already, underway against other groups requiring vaccination against COVID-19[6]; these include but are not limited to hospitals,[7] universities,[8] detention centers,[9] and corporations.[10] While state-imposed compulsory vaccination laws during a public health emergency have long been deemed constitutional under the landmark 1905 Supreme Court case of *Jacobson v. Massachusetts*,[11] and federally sanctioned vaccine mandates are contended to be lawful as well under the Occupational Safety and Health Act of 1970,[12] principles of bioethics and public health law dictate that any intervention that impinges on autonomy be reasonable and necessary.[13] This criteria would arguably be fulfilled by demonstrating that a time-limited trial of voluntary vaccination has failed to produce sufficient vaccine uptake, and that many of the same unvaccinated child care providers also are not practicing nonpharmaceutical interventions.

In this study, we assessed whether unvaccinated child care providers in the U.S. were likely to employ nonpharmaceutical interventions in their nonwork lives (i.e., personal mitigation measures such as masking, social distancing, handwashing, etc.) and child care programs (i.e., classroom mitigation measures such as temperature checks of staff/children, symptom screening for staff/children, staggered pick-up/drop-off times, etc.). Specifically, we assessed whether a lower adherence to personal mitigation measures and/or employment in a program with weaker implementation of classroom mitigation measures are predictive of providers being vaccinated as an alternative form of protection. A negative finding would reinforce the necessity of vaccine mandates in protecting the health and safety of the 2.1 million center- and home-based child care providers and the susceptible infants and young children in their care.[14,15]

II. METHODS

Sample

Child care providers (*N* = 20,013) in all 50 states, the District of Colombia, and Puerto Rico were identified through state child care workforce registries coordinated by the National Workforce Registry Alliance and national child care provider contact lists maintained by the National Association for the Education of Young Children and Child Care Aware of America.[16] Participants were invited to complete a self-administered email survey via Qualtrics (Qualtrics, Provo, UT). Eligible individuals were child care providers ≥18 years old and employed in the child care industry in 2020. All participants provided informed consent prior to data collection. The research protocol was approved by the Yale University Institutional Review Board (protocol number: 2000028232).

Data Collection

The baseline survey assessing predictors (personal and classroom mitigation measures) occurred May-June 2020, and the follow-up survey assessing outcome (COVID-19 vaccination) occurred May-June 2021. Surveys consisted of questions assessing child care providers' race, ethnicity, age, annual income level, current employment status in child care, comorbidities (e.g., diabetes, heart disease, asthma), history of COVID-19, COVID-19 vaccination status, personal mitigation measures, and child care program classroom mitigation measures (as reported by the child care provider; Table 1). All survey questions were closed-ended with nominal answering scales.

Measures

Predictors: Personal mitigation measures employed by child care providers in their nonwork lives (e.g., masking, social distancing, handwashing) consisted of 10 nonpharmaceutical interventions grouped into three factors (listed in Table 2 under 'Personal Mitigation Measures') using principle component analysis accounting for 54.2% of total variance, as previously described.[3] Classroom mitigation measures employed in the providers' child care program (e.g., child/staff symptom screening, child/staff temperature checks, cohorting) consisted of 11 nonpharmaceutical interventions grouped into three factors (listed in Table 2 under 'Classroom Mitigation Measures'), supported by confirmatory factor analysis, showing good model fit (CFI = 0.994, TLI = 0.992, RMSEA = 0.044, SRMR = 0.048). Standardized factor loadings were significant and strong for all items: Factor 1 ('Screening') = 0.881-0.971; Factor 2 ('Masking') = 0.844-0.998; and Factor 3 ('Cohorting') = 0.625-0.710. The methodology of the confirmatory factor analysis is further described in the supplementary appendix. Considering clearly identified classroom mitigation practices in the Center for Disease Control and Prevention's (CDC) COVID-19 Guidance for operating child care programs, we used a confirmatory method to test how items relate to predefined Masking, Screening, and Cohorting factors. However, we chose an

explanatory data reduction method—principal component analysis—for personal mitigation measures to identify underlying dimensions of the child care providers' response patterns because these items were created specifically for the current study with no *a priori* factor considerations.

Outcome: COVID-19 vaccine uptake was measured during the 2021 follow-up survey. Participants were asked whether they were vaccinated against COVID-19.

Data Analysis

Data were weighted based on age, race, ethnicity, and state to match employed child care providers who were 18 years of age or older in the U.S. based on the 2015-2019 American Community Survey (ACS) (occupation code: 4600).[17] Weights were trimmed bottom and top at 2.5%.

Descriptive statistics were calculated for sample demographic characteristics, personal mitigation measures, and classroom mitigation measures. T-tests were used to assess the association between personal and classroom mitigation measures in 2020 and 2021.

To test the association between child care provider's use of personal mitigation measures in 2020 and receipt of COVID-19 vaccination in 2021, a Poisson regression with robust standard error calculation was performed. We created a summed score for personal mitigation measures by adding all the different nonpharmaceutical interventions and used this as our primary predictor of interest. This score ranged from 0 to 10. Two approaches were used in the analysis: one used individual personal mitigation measures ('Model 1') and the other used the summed scores of personal mitigation measures ('Model 2'). Adjusted results controlled for age, race, ethnicity, annual income, existing co-morbidities, history of COVID-19, type of child care setting, direct work with children, county-level background COVID-19

transmission rates, and other personal/classroom mitigation measures (i.e., when looking at the association between factor 1 personal mitigation measures and COVID-19 vaccination, we controlled for factor 2 personal mitigation measures, factor 3 personal mitigation measures, and factor 1-3 classroom mitigation measures). Data on county-level COVID-19 transmission rates were extracted from Johns Hopkins University's COVID-19 repository for the median date the survey was administered (June 9, 2021). Cumulative COVID-19 prevalence rates for June 9 were calculated using county populations from ACS 2015-2019, and were trichotomized into proportionally equal thirds: low, moderate, and high.

To test the association between a child care program's use of classroom mitigation measures in 2020 and a child care provider's receipt of COVID-19 vaccination in 2021, the same approach was taken as above. Data were analyzed using R (Version R.4.1.1; The R Foundation, Indianapolis, Indiana). All reported statistics are for adjusted analysis on the weighted sample unless otherwise specified. The funders/sponsors did not participate in the work.

III. RESULTS

A total of 44,771 respondents completed the 2020 baseline survey, met inclusion criteria, and agreed to future surveys. For the 2021 follow-up survey, 20,013 (44.7%) respondents completed the survey and provided the data necessary to determine the outcomes of interest. Participant baseline characteristics are reported in Table 1 and the supplementary appendix.

Uptake of Nonpharmaceutical Interventions

The uptake of all personal mitigation measures except one (facial masking of child care provider) decreased between 2020 and 2021 (range: 70.9 and 96.6% in 2020; and 58.4 and 92.3% in 2021), whereas all classroom mitigation measures except one (staggered arrival and pick-up times at child care

program) increased over the same period (range: 10.5 and 85.6% in 2020; and 46.4 and 89.6% in 2021). Unvaccinated providers were found to have a lower uptake of all personal mitigation measures (59% versus 74% percent averaged between the 10 measures in the follow-up survey, $p < 0.01$). Results can be found summarized in Table 2.

Uptake of COVID-19 Vaccination

The COVID-19 vaccination rate among U.S. child care providers has been described by our team previously.[16] The overall vaccine uptake among providers at the time of the follow-up survey was 78.2% [90% CI 77.5% to 78.9%].

Uptake of Nonpharmaceutical Interventions in Relationship to COVID-19 Vaccination

Child care providers who reported using more personal mitigation measures in 2020 were also more likely to be vaccinated in 2021. For *each* personal mitigation measure that a provider used in 2020, the likelihood of vaccination in 2021 increased by 7% (e.g., relative to a child care provider who used only 5 personal mitigation measures in 2020, a provider who used all 10 measures would be 5 x 7% or 35% more likely to be vaccinated in 2021; Risk Ratio = 1.07 [95% CI 1.05 – 1.08]). Stated inversely, a child care provider who used less personal mitigation measures in 2020 was also less likely to be vaccinated in 2021 (Risk Ratio = 1/1.07 or 0.93 [95% 0.93 – 0.95]). Results can be found summarized in Table 3.

Unlike the case with personal mitigation measures, there was no significant association between the use of classroom mitigation measures employed by a child care program in 2020 to the COVID-19 vaccination status of a child care provider in said program the following year (Risk Ratio = 1.00 [95% CI 0.99 – 1.00]). In other words, a program that had a lower use of classroom mitigation measures was not

associated with a provider pursuing COVID-19 vaccination one year later as an alternative form of protection. Results can be found summarized in Table 3.

IV. DISCUSSION

In this prospective cohort study on the use of nonpharmaceutical interventions in relationship to COVID-19 vaccination among U.S. child care providers, several findings may support a role for mandatory vaccination in child care programs to promote pandemic control.

First, child care providers who were less likely to use personal mitigation measures were also less likely to get vaccinated. For each personal mitigation measure that a child care provider was nonadherent to in 2020, the likelihood of vaccination decreased by 7% in 2021. The decrease was more pronounced at 19% for personal mitigation measures shown to be highly effective and/or endorsed most prominently by public health officials (masking, social distancing, and/or handwashing).[18-20] This may be for several reasons: The politicization of masking and vaccination may have led some child care providers to make medical decisions for nonmedical reasons surrounding partisan ideology[21,22]; membership in social networks may have descriptive and/or injunctive social norms that disfavor both[23]; and the growing distrust of science, medical establishments, and government may have led some child care providers to seek alternative sources of information that may have been misleading.[24-27] Thus, the nonadherence to multiple types of preventative health behaviors among child care providers, including both masking and vaccination, and the potentially deep seated reasons underlying that nonadherence, speak to the gains that could be realized by mandatory vaccination in preventing COVID-19.

Second, there was not a significant association between classroom mitigation measures implemented at a child care program and the vaccination status of the child care provider. This suggests that an

employer's programmatic risk reduction policies did not influence a child care provider's decision to vaccinate against COVID-19. In the context of the findings above, this relationship, or lack thereof, suggests that neither the suboptimal use of personal mitigation measures by a child care provider, nor classroom mitigation measures by a child care program, was positively associated with the receipt of COVID-19 vaccination as an alternative form of protection. That unprotected child care providers continue to congregate within a vulnerable child care program may support a role for mandatory vaccination to reduce the number of susceptible hosts and the risk of a classroom outbreak.

Finally, it is worth noting the discrepancy between the use of personal mitigation measures by child care providers and the use of classroom mitigation measures in child care programs over time. Whereas the use of most personal mitigation measures by providers decreased between 2020 and 2021, the use of most classroom mitigation measures by programs increased over the same interval. The selective decrease in the use of personal mitigation measures over time can likely be attributed to several factors, including but not limited to the following: the CDC's liberalization of the nonpharmaceutical intervention guidelines at the time of the follow-up survey (the updated guidelines in May 2021 permitted loosening of personal mitigation measures and maintained the status quo for classroom mitigation measures)[28]; 'Pandemic fatigue'[29]; and lower risk perception in response to both the decreased rates of COVID-19 during the summer and the evolving national vaccination campaign.[30] Notably, although the CDC's updated and less stringent nonpharmaceutical intervention guidelines at the time of the follow-up survey applied *only* to vaccinated child care providers, unvaccinated providers were found to have a lower uptake of *all* personal mitigation measures (59% versus 74% percent averaged between the 10 measures in the follow-up survey). The decrease in the use of personal mitigation measures among child care providers over time, and the nonadherence to the CDC guidelines for nonpharmaceutical

interventions among unvaccinated child care providers, places the focus instead on vaccination as a more durable alternative to reduce community spread of COVID-19.

It is important to acknowledge that while mandatory vaccination may improve COVID-19 vaccine uptake among child care providers, they may also lead some providers—who are either strongly vaccine hesitant or vaccine refusing—to leave their occupation and seek out alternative employment.[31] A further reduction in the supply of child care providers would not be well tolerated by the child care industry, which has been suffering from labor shortages starting prior to the pandemic and continues to operate at only 90% of prepandemic levels.[32] One solution would be to enact soft mandates that allow for opt-out screening for those providers not accepting of vaccination (as has already been adapted by several states[33-35] and the federal government.[5]) Another solution would be to increase the wages of child care providers and absorb the losses by attracting new providers into the workforce (as has been proposed by the American Families Plan.[36]) Protecting the health and safety of child care providers must be balanced with the need to maintain an adequate supply of child care services.

Limitations

Limitations to our study include the following: First, the follow-up survey of child care providers was conducted during May-June 2021; this is prior to the CDC reversal of the nonpharmaceutical intervention guidelines in July 2021 for vaccinated people in response to the B.1.617.2 variant ('Delta'),[37] hence the absolute adherence to nonpharmaceutical interventions of child care providers may now differ. We believe, however, that the relative trends in nonpharmaceutical intervention use between unvaccinated and vaccinated child care providers—the main focus of this paper—are still accurate. Second, about half of the respondents who completed the baseline survey did not complete the follow-up survey; this is likely because the annual turnover rate within some child care programs is as high as

26-40%, and, as such, many of the child care providers who were surveyed initially would no longer be able to—or even eligible to—respond (potentially introducing nonresponse bias)[32]. Third, the respondents of our survey were also those who had previously expressed an interest in completing future surveys, and it is possible that the uptake of nonpharmaceutical interventions and vaccination among this group may not be representative of child care providers at large (potentially introducing selection bias). Finally, we used an observational study design to assess the relationship between nonpharmaceutical interventions and COVID-19 vaccination, and there may be unknown confounders that we have not taken into consideration (although we do control for over 10 known confounders). The major strengths of our study include a large national sample weighted to representativeness, a comprehensive assessment of >20 different nonpharmaceutical interventions, and the provision of the survey in both English and Spanish to capture the practices of those with limited English proficiency (in a disproportionately female and minority child care population that has historically been marginalized and difficult to study).

V. CONCLUSION

In reviewing the uptake of nonpharmaceutical interventions in relation to COVID-19 vaccination among U.S. child care settings, we found that neither the suboptimal use of personal mitigation measures by a child care provider, nor classroom mitigation measures by a child care program, was positively associated with COVID-19 vaccination as an alternative form of protection – perhaps increasing the risk of COVID-19 transmission to children and families. The findings may support a role for mandatory vaccination among child care providers, as has already been adapted by several states[4] and the federal government[5], to achieve pandemic control.

2817 words

VI. REFERENCES

1. LaFraniere S, Weiland N. F.D.A. Fully Approves Pfizer-BioNTech's Vaccine, a First for a Covid-19 Shot. The New York Times 2021.
2. Slotnik DE, Cooper H. With F.D.A. approval for a Covid vaccine, the Pentagon and others add vaccine requirements. The New York Times 2021.
3. Gilliam WS, Malik AA, Shafiq M, et al. COVID-19 transmission in US child care programs. Pediatrics 2021;147(1).
4. Patel KM, Gilliam W, Omer SB. State Vaccine Mandates for COVID-19 – An Emerging Disparity between Childcare Providers and School Teachers. Social Science Research Network 2021 (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3960121).
5. Megerian C. 'Our patience is wearing thin': Biden extends vaccine mandates as COVID toll rises. Los Angeles Times 2021.
6. Randall LH, Curran EA, Omer SB. Legal considerations surrounding mandatory influenza vaccination for healthcare workers in the United States. Vaccine 2013;31(14):1771-6. DOI: 10.1016/j.vaccine.2013.02.002.
7. Kaplan S. A judge dismisses Houston hospital workers' lawsuit about vaccine mandates. The New York Times 2021.
8. Liptak A. The Supreme Court won't block Indiana University's vaccine mandate. The New York Times 2021.
9. Bade B. Detention officer files lawsuit against Dona Ana Co. over vaccine mandate. KRQE 2021.
10. Stanley-Becker I. Resistance to vaccine mandates is building. A powerful network is helping. The Washington Post 2021 (https://www.washingtonpost.com/health/2021/05/26/vaccine-mandate-litigation-siri-glimstad-ican/).
11. Mello MM, Parmet WE. Public Health Law after Covid-19. New England Journal of Medicine 2021.
12. Shear MD. Biden's Authority to Mandate Vaccines Stems From Law Protecting Workers From 'Grave Dangers'. The New York Times2021.
13. Mello MM, Silverman RD, Omer SB. Ensuring Uptake of Vaccines against SARS-CoV-2. N Engl J Med 2020. DOI: 10.1056/NEJMp2020926.
14. OPRE. Home-based Early Care and Education Providers in 2012 and 2019: Counts and Characteristics. In: HHS, ed.2021.
15. Datta AR, Milesi C, Srivastava S, Zapata-Gietl C. Home-Based Early Care and Education Providers in 2012 and 2019: Counts and Characteristics. Chartbook. National Survey of Early Care & Education. OPRE Report 2021-85. Administration for Children & Families 2021.
16. Patel KM, Malik AA, Lee A, et al. COVID-19 Vaccine Uptake Among US Child Care Providers. Pediatrics 2021.
17. US-Census-Bureau. American Community Survey 2015-2019 5-Year Data Release. United States Census Bureau. (https://www.census.gov/newsroom/press-kits/2020/acs-5-year.html).

18. Milne GJ, Xie S. The effectiveness of social distancing in mitigating COVID-19 spread: a modelling analysis. MedRxiv 2020.
19. Brooks JT, Butler JC. Effectiveness of mask wearing to control community spread of SARS-CoV-2. Jama 2021;325(10):998-999.
20. Higgins-Dunn N. Dr. Fauci says it's important to wear a mask even after getting the Covid vaccine. Here's why. CNBC. CNBC2021.
21. Rojas R. Masks Become a Flash Point in the Virus Culture Wars. The New York Times 2021.
22. Russonello G. The Rising Politicization of Covid Vaccines. The New York Times2021.
23. Brewer NT, Chapman GB, Rothman AJ, Leask J, Kempe A. Increasing vaccination: putting psychological science into action. Psychological Science in the Public Interest 2017;18(3):149-207.
24. Rosenbaum L. Escaping catch-22—overcoming covid vaccine hesitancy. Mass Medical Soc; 2021.
25. Rosenbaum L. No Cure without Care—Soothing Science Skepticism. Mass Medical Soc; 2021.
26. Warren RC, Forrow L, Hodge Sr DA, Truog RD. Trustworthiness before trust—Covid-19 vaccine trials and the Black community. New England Journal of Medicine 2020;383(22):e121.
27. Bajaj SS, Stanford FC. Beyond Tuskegee—Vaccine distrust and everyday racism. New England Journal of Medicine 2021;384(5):e12.
28. Rabin RC, Mandavilli A, Weiland N. Vaccinated Americans May Go Without Masks in Most Places, Federal Officials Say. The New York Times 2021.
29. Meichtry S, Sugden J, Barnett A. Pandemic fatigue is real–And it's spreading. Wall Street Journal 2020.
30. Elharake JA, Shafiq M, McFadden SM, Malik AA, Omer SB. The Association of COVID-19 Risk Perception, County Death Rates, and Voluntary Health Behaviors among US Adult Population. The Journal of Infectious Diseases 2021.
31. Mongeau L. Vaccine mandates could make it harder to find child care workers. The Hechinger Report. The Hechinger Report2021.
32. United-States-Deptartment-of-the-Treasury. The Economics of Child Care Supply in the United States. 2021.
33. Inslee J. Inslee announces educator vaccination requirement and statewide indoor mask mandate. State of Washington; 2021.
34. Office-of-the-Governor. Governor Murphy Signs Executive Order Instituting Vaccination or Testing Requirement for All Child Care Center Personnel. State of New Jersey Website 2021.
35. Lamont N. Governor Lamont Announces State Employees, Childcare, and School Staff Will Be Required To Get Vaccinated for COVID-19. State of Connecticut; 2021.
36. The-White-House-Statements-and-Releases. FACT SHEET: The American Families Plan. whitehouse.gov2021.
37. Slotnik DE, Mandavilli A, Stolberg SG. Here's what we know about the C.D.C.'s new mask recommendations for vaccinated people. The New York Times2021.

38. Hu Lt, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural equation modeling: a multidisciplinary journal 1999;6(1):1-55.
39. DiStefano C, Morgan GB. A comparison of diagonal weighted least squares robust estimation techniques for ordinal data. Structural Equation Modeling: A Multidisciplinary Journal 2014;21(3):425-438.

VII. TABLES & FIGURES

Table 1: Baseline Characteristics of U.S. Child Care Providers		
	Unweighted N (%)	***Weighted N (%)**
Overall		
All Respondents	20013	19992
Age Group		
18 - 24	380 (1.9)	1642 (8.2)
25 - 34	2400 (12.0)	4126 (20.7)
35 - 44	4637 (23.2)	4144 (20.7)
45 - 54	6053 (30.3)	4653 (23.3)
55 - 64	5078 (25.4)	3907 (19.6)
65 - 74	1339 (6.7)	1284 (6.4)
75 - 84	94 (0.5)	204 (1.0)
Race		
White	14848 (76.3)	13456 (69.2)
Black or African American	2132 (11.0)	2693 (13.9)
American Indian or Alaskan Native	172 (0.9)	348 (1.8)
Asian	567 (2.9)	648 (3.3)
Native Hawaiian or Other Pacific Islander	53 (0.3)	88 (0.5)
Multiracial	409 (2.1)	827 (4.3)
Prefer not to answer	1278 (6.6)	1374 (7.1)
Ethnicity		
Hispanic	3257 (16.3)	3742 (18.8)
Not Hispanic	16377 (82.2)	15869 (79.7)
Prefer not to answer	293 (1.5)	287 (1.4)
Annual Household Income		
<$35,000	3499 (17.5)	4135 (20.7)
$35,000 - $49,999	3308 (16.6)	3435 (17.2)
$50,000 - $74,999	4151 (20.8)	4079 (20.4)
>$75,000	6466 (32.4)	5898 (29.5)
Prefer not to answer	2557 (12.8)	2415 (12.1)
History of COVID-19		
Yes	2869 (14.4)	3108 (15.6)
No	17008 (85.6)	16772 (84.4)
Type of Child Care Program		
Home-based	5112 (28.4)	4839 (26.8)
Center-based	12887 (71.6)	13242 (73.2)
Comorbidities		
Heart Disease	1035 (5.2)	979 (4.9)
Asthma	2862 (14.3)	2898 (14.5)
Chronic Lung Disease or COPD	229 (1.1)	180 (0.9)
Smoker	831 (4.2)	805 (4.0)
Diabetes	1411 (7.1)	1308 (6.5)
Obesity	4786 (23.9)	4529 (22.7)
Chronic/Severe Kidney Disease	136 (0.7)	116 (0.6)
Liver Disease	133 (0.7)	121 (0.6)
Immune-weakening Medications	1073 (5.4)	967 (4.8)
Immune-compromising Conditions	459 (2.3)	456 (2.3)
COVID-19 Background Transmission		
Low (< 86.1 cases per 1000)	6783 (33.9)	6326 (31.7)
Moderate (86.2 – 107 cases per 1000)	6641 (33.2)	6285 (31.4)
High (> 107.1 cases per 1000)	6580 (32.9)	7374 (36.9)

*Data were weighted based on age, race, ethnicity, and state to match employed child care providers (occupation code: 4600) who were 18 years of age or older in the U.S. based on the 2015-2019 American Community Survey.

Table 2: Use of Nonpharmaceutical Interventions by U.S. Child Care Providers in 2020 and 2021						
Type of Nonpharmaceutical Interventions	**Percent (%) Reporting in Baseline Survey (2020)**	**Percent (%) Reporting in Follow-up Survey (2021)**	**Range**	**Mean (SD) 2020**	**Mean (SD) 2021**	**T-statistic (p-value)**
Personal Mitigation Measures						
Factor 1: 'Masking, Social Distancing, Handwashing'	-	-	0-3	2.78 (0.51)	2.70 (0.67)	13.26
Tried to Maintain at least 6 feet from others when outside home	96.6	86.7	-	-	-	(<0.001)
∗Facial coverings/mask almost always when outside home	84.8	91.1	-	-	-	-
Frequent handwashing/sanitizing when outside home	96.6	92.3	-	-	-	-
Factor 2: 'Avoiding Social Interactions'	-	-	0-3	2.11 (1.03)	1.42 (1.21)	61.09
Asked family/friends not to visit	60.0	35.4	-	-	-	(<0.001)
Avoided extended family and friends even if not symptomatic	80.0	54.6	-	-	-	-
Avoided eating outside home	70.9	52.3	-	-	-	-
Factor 3: 'Avoiding High Risk Situations/Travel'	-	-	0-4	3.52 (0.90)	2.71 (0.66)	47.52
Avoided close contacts with people who were sick	93.1	90.6	-	-	-	(<0.001)
Avoided traveling to high risk COVID-19 infection places	85.9	78.4	-	-	-	-
Avoided social events would normally attend	91.5	73.0	-	-	-	-
Canceled business trips, social trips, vacations	81.2	58.4	-	-	-	-
Classroom Mitigation Measures						
Factor 1: 'Symptom Screening & Temperature Checks'	-	-	0-4	3.00 (1.49)	3.20 (1.32)	3.94
Child Screening for Symptoms	79.1	85.1	-	-	-	(<0.001)
Staff Screening for Symptoms	75.5	79.1	-	-	-	-
Child Temperature Checks	77.0	82.0	-	-	-	-
Staff Temperature Checks	69.8	73.9	-	-	-	-
Factor 2: 'Staff and Child Masking'	-	-	0-2	0.46 (0.67)	1.24 (0.78)	41.83
∗Staff masking	36.1	77.8	-	-	-	(<0.001)
Child Masking	10.5	46.4	-	-	-	-
Factor 3: 'Cohorting'	-	-	0-5	3.20 (1.52)	3.43 (1.43)	5.85
Children from different groups do not mix or interact	54.0	59.9	-	-	-	(<0.001)
Materials not shared between children or groups	67.4	69.1	-	-	-	-
Staggered arrival and pick-up times	48.8	48.4	-	-	-	-
Children are picked up and dropped off outside of the program	61.7	73.0	-	-	-	-
The program refrains from sharing food or communal eating	85.6	89.6	-	-	-	-

*The item 'Facial coverings/mask almost always when outside home' under the subheading of 'Personal Mitigation Measures' refers to *self*-masking (of the child care provider), whereas the item 'Staff masking' under the subheading of 'Classroom Mitigation Measures' refers to masking of *others* in the child care program (as observed by the child care provider)

Table 3: Risk Ratio Between Use of Nonpharmaceutical Interventions in 2020 and COVID-19 Vaccination in 2021 Among U.S. Child Care Providers						
Type of Nonpharmaceutical Interventions	**Unadjusted Model**		**Adjusted Model 1***		**Adjusted Model 2***	
	Risk Ratio (95% CI)	**P value**	**Risk Ratio (95% CI)**	**P value**	**Risk Ratio (95% CI)**	**P value**
Personal Mitigation Measures						
Factor 1: 'Masking, Social Distancing, Handwashing'	1.29 (1.25 – 1.34)	<0.001	1.24 (1.16 – 1.32)	<0.001	-	-
Factor 2: 'Avoiding Social Interactions'	1.09 (1.08 – 1.11)	<0.001	1.05 (1.02 – 1.08)	0.002	-	-
Factor 3: 'Avoiding High Risk Situations'	1.10 (1.08 – 1.11)	<0.001	1.03 (0.99 – 1.07)	0.176	-	-
All (summed across)	1.06 (1.06 – 1.07)	<0.001	-	-	1.07 (1.05 – 1.08) †	<0.001
Classroom Mitigation Measures						
Factor 1: 'Symptom and Temperature Checks'	1.03 (1.01 – 1.04)	<0.001	1.00 (0.98 – 1.02)	0.869	-	-
Factor 2: 'Staff and Child Masking'	1.07 (1.04 – 1.10)	<0.001	1.00 (0.96 – 1.04)	0.984	-	-
Factor 3: 'Cohorting'	1.02 (1.01 – 1.03)	0.007	0.98 (0.97 – 1.00)	0.126	-	-
All (summed across)	1.01 (1.01 – 1.02)	<0.001	-	-	1.00 (0.99 – 1.00) ‡	0.373

*Adjusted for age, race, ethnicity, annual income, existing co-morbidities, history of COVID-19, type of child care setting, direct work with children, county-level background COVID-19 transmission rates, and other personal/classroom mitigation measures (i.e., when looking at the association between factor 1 personal mitigation measures and COVID-19 vaccination, we controlled for factor 2 personal mitigation measures, factor 3 personal mitigation measures, and factor 1-3 classroom mitigation measures)

†Interpretation: For *each* personal mitigation measure that a provider used in 2020, the likelihood of vaccination in 2021 increased by 7% (e.g., relative to a child care provider who used only 5 personal mitigation measures in 2020, a provider who used all 10 measures would be 5 x 7% or 35% more likely to be vaccinated in 2021; Risk Ratio = 1.07 [95% CI 1.05 – 1.08]). Stated inversely, a child care who used less personal mitigation measures in 2020 was also less likely to be vaccinated in 2021 (Risk Ratio = 1/1.07 or 0.93 [95% 0.93 – 0.95]).

‡Interpretation: There was no significant correlation between the use of classroom mitigation measures by child care *program* in 2020 to COVID-19 vaccination by child care *provider* in 2021 (Risk Ratio = 1.00 [95% CI 0.99 – 1.00]). In other words, a program that had a lower use of classroom mitigation measures was not associated with a provider pursuing COVID-19 vaccination in the future as an alternative form of protection.