Received: 29 November 2021 | Revised: 7 April 2022 | Accepted: 27 April 2022

DOI: 10.1002/hsr2.658

ORIGINAL RESEARCH

Health Science Reports Open Access WILEY

The impact of community closures among nonessential and essential workers, Nashville, Tennessee: A cross-sectional study

Danielle A. Rankin[1,2] | **Ahmad Yanis**[1] | **Zaid Haddadin**[1] | **Rana Talj**[1] | **Kailee N. Fernandez**[1] | **Sean M. Bloos**[1] | **Anna Stahl**[1] | **Wenying Gu**[1] | **Janet Nicotera**[1] | **Harrison L. Howe**[1] | **Seifein Salib**[1] | **James Chappell**[1] | **Leigh M. Howard**[1] | **Nikhil K. Khankari**[3,4] | **Natasha B. Halasa**[1]

[1]Department of Pediatrics, Vanderbilt University Medical Center, Nashville, Tennessee, USA

[2]Vanderbilt Epidemiology PhD Program, Vanderbilt University School of Medicine, Nashville, Tennessee, USA

[3]Division of Genetic Medicine, Department of Medicine, Vanderbilt University Medical Center, Nashville, Tennessee, USA

[4]Vanderbilt Genetics Institute, Vanderbilt University Medical Center, Nashville, Tennessee, USA

Correspondence

Danielle A. Rankin, MPH, Vanderbilt University School of Medicine, Vanderbilt Epidemiology PhD Program, 1161 21st Ave South, D7232 MCN, Nashville, TN 37232, USA.
Email: Danielle.A.Rankin@vanderbilt.edu

Funding information

National Institutes of Health; Vanderbilt University Medical Center, Division of Pediatrics; Vanderbilt University Dance Marathon Fund; National Center for Advancing Translational Sciences

Abstract

Background and Aims: The effects of community closures and relaxing social distancing restrictions on severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) by occupational risk remain unclear. Therefore, we evaluated the impact of community closures and reopening phases with the prevalence of testing SARS-CoV-2-positive among nonessential and essential workers.

Methods: We constructed a cross-sectional cohort from March 20 to July 31, 2020, of 344 adults from Metropolitan Nashville, Tennessee. We performed an unconditional logistic regression model to evaluate the impact of community closures and phase implementation on testing SARS-CoV-2 positive by occupation to estimate adjusted prevalence odds ratios (aPORs) and 95% confidence intervals (CIs).

Results: During a stay-at-home/Phase I order, those with non-essential occupations had 59% decreased prevalence odds (aPOR:0.41; 95% CI: 0.20–0.84) of testing SARS-CoV-2-positive compared to when no restrictions were in place. Persons with essential occupations had four times the prevalence odds of testing SARS-CoV-2-positive (aPOR:4.19; 95% CI:1.57–11.18) compared with non-essential occupations when no community restrictions were established.

Conclusion: Stay-at-home restrictions were associated with a lower risk of SARS-CoV-2 infection in the community for nonessential workers. Essential employees remained at increased risk for SARS-CoV-2, including when no community restrictions were in place and vaccines were not available. This study supports targeting prevention measures for these high-risk occupations.

KEYWORDS

community closures, COVID-19 social mitigation measures, essential occupations, public health interventions in response to COVID-19, SARS-CoV-2

Dr. Halasa and Dr. Khankari should be considered as co-senior authors.

1 | INTRODUCTION

To control the transmission of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) before vaccine availability, US public health officials implemented several community interventions. These measures specified mandatory mask-wearing, emphasis on hand hygiene, limiting patron densities at social venues (e.g., restaurants and bars), restricting mass gatherings, nonessential business closures, and stay-at-home orders.[1] On March 23, 2020, the Metro Public Health Department in Nashville, Tennessee issued a stay-at-home order for non-essential workers in Davidson County[2]; and by March 31, 2020, the Tennessee governor issued a state-wide mandate.[3] Despite these pandemic-related interventions, individuals in professions essential to continue infrastructural operations were still required to attend work, regardless of the phase of restrictions.[4,5] Essential occupations included individuals in healthcare (i.e., emergency responders, nurses, physicians, environmental services, and nursing assistants), correctional facilities, transportation, agricultural, food production (meat and poultry factories), construction, grocery stores, pharmacies, and energy sectors.[4,5]

Empiric evidence examining the effects of community closures and phase reopening on the risk of coronavirus disease 2019 (COVID-19) among the essential workforce is limited. The goal of our study was to assess the impact of community closures and reopening phases on testing positive for SARS-CoV-2 in Metropolitan Nashville, Tennessee, with a focus on examining differences by occupation, before the introduction of the SARS-CoV-2 vaccine.

2 | MATERIALS AND METHODS

2.1 | Study design and population

We conducted a cross-sectional study from our main longitudinal community-based SARS-CoV-2 surveillance study, COPE (**C**OVID-19, **O**utbreak, **P**andemic, **E**xploration). Adults (≥18 years) who resided in Metropolitan Nashville, Tennessee between March 20 and July 31, 2020, were eligible if one member within a household had SARS-CoV-2-infection confirmed by molecular testing for SARS-CoV-2 from a Vanderbilt University Medical Center affiliated testing location (i.e., emergency room, hospital, testing site, and outpatient clinic) or another testing site (e.g., health department, local pharmacy, etc.). Participants were recruited and enrolled if they opted into providing their contact information for research after verbal Informed consent was obtained. This study was approved by the Institutional Review Board at Vanderbilt University and followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines for cross-sectional studies (Figure S1).

2.2 | Data and specimen collection

Telephone interviews were conducted by trained research personnel to record demographics, occupation, underlying medical conditions, illness history, testing location, and social histories using a standardized case report form. Travel history was included if the person traveled within 14 days before illness onset or enrollment date if the person was asymptomatic. Results from clinical SARS-CoV-2 tests were reviewed and verified. Trained research personnel scheduled and collected research blood specimens at each participant's property within 6 weeks following enrollment. Sera collected on March 20–July 21, 2020, were provided to the Tennessee Department of Health, Division for Laboratory Services for SARS-CoV-2 antibody detection using the Architect SARS-CoV-2 IgG assay (Abbott). All data and laboratory results were maintained in a secure REDCap™ (Research Electronic Data Capture, Vanderbilt University) database.[6]

2.3 | Community phases

Phases were defined as the following: no restrictions (referent), stay-at-home order/Phase I, or Phase II/Phase III. The date of symptom onset or date of SARS-CoV-2 testing in asymptomatic persons determined their phase classification. Persons were classified in a specific phase based on their residential postal zip code along with the county or state emergency operation orders that were in effect.[2,3,7,8]

2.4 | Nonessential versus essential workers

Type of occupation was dichotomized as nonessential (i.e., unemployed or persons working from home [referent]) and essential (i.e., work in professions with contact to people [e.g., frontline, healthcare, grocery, transit, factory, construction, and retail employees, etc.]).[9] Persons holding essential occupations, but reported working from home during enrollment, were assigned to the nonessential group.

2.5 | Outcome

The outcome of our study was defined as laboratory-confirmed SARS-CoV-2-positive. Evidence of SARS-CoV-2 infection was defined by detection of nasal viral genomic RNA using reverse-transcriptase quantitative polymerase chain reaction (RT-qPCR) and/or by detection of serum IgG to SARS-CoV-2 using a chemiluminescent microparticle immunoassay. Those with negative RT-qPCR results but positive SARS-CoV-2 serology within 6 weeks of symptom onset were classified as SARS-CoV-2-positive.

2.6 | Statistical analysis

Potential confounders were identified using directed acyclic graphs and evaluated using a 10% change in estimate criterion (Figure S2). Missing data was assessed and a total of 344 adults (100%) had complete data for all variables. Interactions between dichotomized occupational exposure (i.e., nonessential, essential) and phase implementation (i.e., no restrictions, stay-at-home/Phase I, and Phase II/III) with SARS-CoV-2 prevalence were assessed on the additive and multiplicative scales. Additive interactions were evaluated using the relative excess prevalence odds due to interaction (REPI), with 95% confidence intervals (CIs).[10] Multiplicative interactions were evaluated using the likelihood ratio test (LRT) for nested models comparing model fit of two models with and without the inclusion of the multiplicative interaction term ($p < 0.20$). Unconditional logistic regression was used to evaluate phase implementation and its impact on SARS-CoV-2 prevalence for phase and occupational exposure adjusted for sex (male/female) and ethnicity (Hispanic/non-Hispanic) to estimate adjusted prevalence odds ratios (aPORs) and 95% CIs. Statistical significance was based on two-tailed tests with $\alpha = 5\%$. A sensitivity analysis excluding persons in healthcare professions was performed. All analyses were conducted using statistical software Stata 16.0 (StataCorp LLC).

3 | RESULTS

Of the 344 adults, 256 (74%) were SARS-CoV-2-positive (RTq-PCR = 235; serology = 22). The mean age was 42 years (SD = 14), 51% were female, 88% were White, and 45% were in essential occupations (Table 1). The majority of our cohort resided in Davidson County ($n = 246$; [72%], which followed more stringent reopening plans than other Metropolitan counties (Figure 1). Overall, 97% (248/256) of persons with SARS-CoV-2 reported having COVID-like symptoms; and all eight of the asymptomatic individuals with SARS-CoV-2-positive tests worked in essential occupations. Persons in essential occupations

TABLE 1 Sociodemographic characteristics of individuals in metropolitan Nashville, Tennessee by occupations[a].

Characteristic	Total ($n = 344$)	Nonessential ($n = 190$)	Essential ($n = 154$)	p value[b]
Age, years—mean (SD)	42 (14)	43 (14)	40 (13)	0.04
Sex, female—no. (%)	177 (51)	110 (58)	67 (44)	0.008
Race—no. (%)				
White	304 (88)	174 (92)	130 (84)	0.01
Black	10 (3)	7 (4)	3 (2)	
Other	30 (9)	9 (5)	21 (14)	
Ethnicity, Hispanic—no. (%)	38 (11)	12 (6)	26 (17)	0.002
Insurance—no. (%)				
None/Self-pay	27 (8)	11 (6)	16 (10)	0.10
Public	18 (5)	13 (7)	5 (3)	
Private	287 (83)	157 (83)	130 (84)	
Both, Private & Public	12 (4)	9 (5)	3 (2)	
Underlying medical condition—no. (%)	100 (29)	63 (33)	37 (24)	0.06
Travel history—no. (%)				
None	296 (86)	158 (83)	138 (90)	0.08
Domestic	39 (11)	24 (13)	15 (10)	
International	9 (3)	8 (4)	1 (1)	
Household size—mean (SD)	4 (1)	4 (1)	3 (2)	0.23
Phase Implementation—no. (%)				
No restrictions (pre-COVID-19)	97 (28)	75 (39)	22 (14)	<0.001
Stay-at-home/Phase I	137 (40)	62 (33)	75 (49)	
Phase II/Phase III	110 (32)	53 (28)	57 (37)	

[a] Occupation exposure risk is defined as non-essential (i.e., not employed or persons working from home) and essential (i.e., attend work in professions with contact to volumes of people)

[b] p values were calculated using t test with unequal variances for continuous variables and Pearson's χ^2 test for categorical variables, alpha set at <0.05. Pairwise comparisons are between non-essential and essential workers.

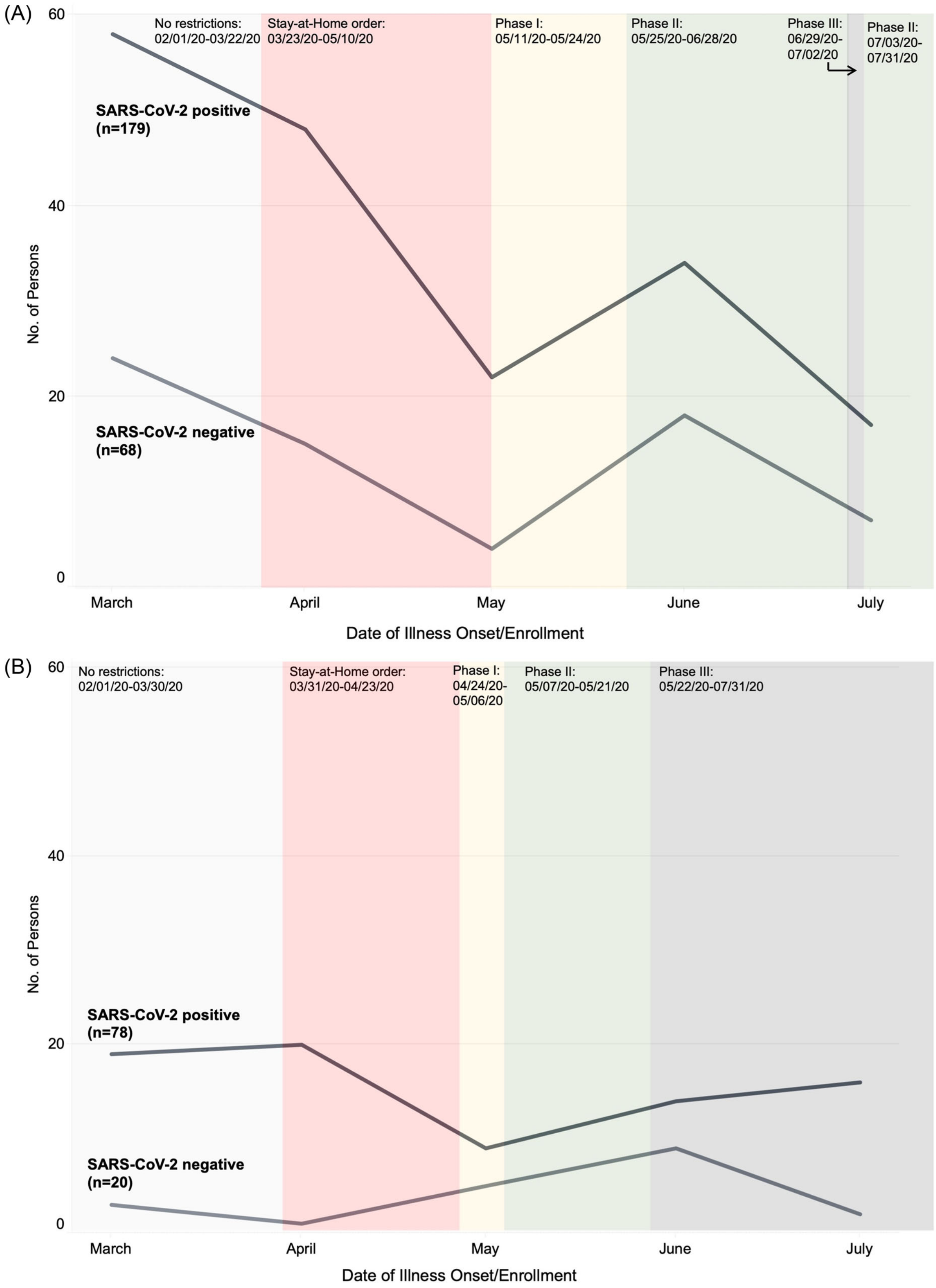

FIGURE 1 Timeline of phase implementation across Davidson (A) and Metropolitan[a] (B) counties in Nashville, Tennessee by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) status—March 2020–July 2020. [a]Metropolitan counties are comprised of the counties neighboring Davidson County.

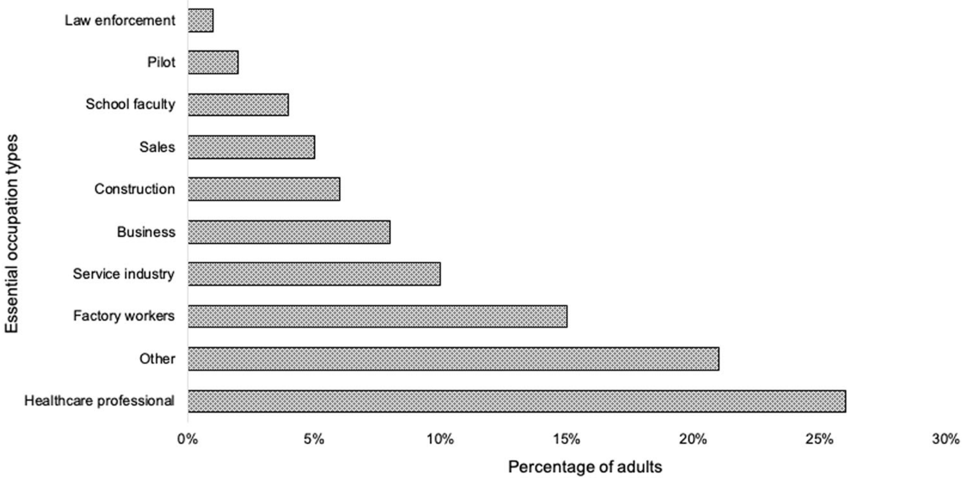

FIGURE 2 Distribution of Persons in essential occupations in Nashville, Tennessee (*n* = 154). Footnote: Other examples of essential occupations include hair stylist, grocery store staff, housekeepers, truck driver, etc.

were more likely to be male and of Hispanic ethnicity than nonessential workers (Table 1). The majority of essential employees were healthcare personnel, in other essential occupations, or factory workers (26%, 21%, and 15%, respectively; Figure 2).

3.1 | Association of phases and occupation type

Persons in nonessential occupations during the stay-at-home/Phase I order had 59% reduced prevalence odds (aPOR: 0.41; 95% CI: 0.20–0.84) of SARS-CoV-2 compared with when no restrictions were in effect (Table 2). In contrast, persons in essential occupations had approximately four times the prevalence odds (aPOR: 4.19; 95% CI: 1.57–11.18) of SARS-CoV-2 compared with nonessential occupations when no restrictions were in effect. We observed an interaction between occupation and phase implementation, which was statistically significant on the multiplicative scale and was 13.6 times more than multiplicative (expected aPOR under complete multiplicativity = 0.31, $p < 0.001$) during the stay-at-home/Phase I order (Table 2). An approximately 400% increased prevalence was observed on the additive scale (REPI = 4.03, 95% CI = −13.15 to 21.22), although this departure from additivity was not statistically significant. As reopening of Metropolitan Nashville continued, there were no associations observed for Phase II/III compared with when no restrictions were in effect. When excluding healthcare professionals, persons in the essential occupations group had over nine times the prevalence odds of (aPOR: 9.42; 95% CI: 2.06–43.00) testing SARS-CoV-2-positive compared to non-essential occupations when no restrictions were in effect (Table S1).

4 | DISCUSSION

Our cross-sectional study of community closures and phase implementation in Metropolitan Nashville, Tennessee from March 20 to July 31, 2020, revealed persons who were unemployed or in non-essential occupations had decreased prevalence odds of testing SARS-CoV-2-positive during the stay-at-home/Phase I order. Conversely, persons employed in essential occupations during a stay-at-home/Phase I mandate had increased prevalence odds of testing SARS-CoV-2-positive compared to persons unemployed or in non-essential occupations when no restrictions were in effect. When healthcare employees were excluded, the effect of testing SARS-CoV-2-positive was two times greater for essential occupations during the stay-at-home/Phase I order. Our findings highlight the importance of the impact of public health phases on SARS-CoV-2 transmission in the community, yet persons working in essential occupations remained at risk for SARS-CoV-2 infection.

Similar to the effect we observed among non-essential employees from our community, Gallaway et al. showed lower SARS-CoV-2 incidence among residents in Arizona during stay-at-home orders; and a subsequent increase in incidence by 151% when restrictions were relaxed.[11] Combined with our results, these findings emphasize the importance of community closures in limiting SARS-CoV-2 and future emerging infectious diseases with pandemic potential.[12] These same community mitigation measures were employed during the 1918 influenza pandemic to help limit community transmission of influenza.[13,14] Therefore, until pharmaceuticals (e.g., effective vaccines and antivirals) are widely available, community closures and public health (nonpharmaceutical) interventions for prevention of future pandemics can be effective in limiting viral transmission.[13,14] However, the risk and benefits of community closures should be taken into consideration given the potential negative effects associated with prolonged community closures.[15]

At least early in the pandemic during stay-at-home/Phase I, we found that essential workers were at increased risk for testing positive for SARS-CoV-2. This heightened risk for SARS-CoV-2 infection among persons holding essential occupations, especially in congregate settings such as those who work in factories, has

TABLE 2 Associations of phase implementation and SARS-CoV-2 in metropolitan Nashville, Tennessee, by occupational risk[a] with a single-referent group[b].

	Nonessential ($n = 190$)					Essential ($n = 154$)					Additivity		Multiplicativity	
	SARS-CoV-2					SARS-CoV-2								
Phase	+	−	aPOR	95% CI	*p* value	+	−	aPOR	95% CI	*p* value	RERI[c]	95% CI[d]	LRT χ2[e]	*p* calue
No restrictions	52	23	REF	REF	REF	14	8	0.76	0.28–2.04	0.581				
Stay-at-Home/Phase I	31	31	0.41	0.20–0.84	0.014	69	6	4.19	1.57–11.18	0.004	4.03	−13.16-21.22	13.45	<0.001
Phase II/III	42	11	1.71	0.74–3.94	0.206	48	9	2.24	0.94–5.33	0.068	0.77	−16.59- 18.13	0.51	0.477

Abbreviations: aPOR, adjusted prevalence odds ratio; CI, confidence interval; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

[a] Occupation exposure risk is defined as nonessential (i.e., not employed or persons working from home) and essential (i.e., attend work in professions with contact to volumes of people).

[b] All aPORs are compared with nonessential occupations during no restrictions.

[c] RERI_{POR}, relative excess prevalence odds due to interaction = $\text{POR}_{11} - \text{POR}_{10} - \text{POR}_{01} + 1$; measures the departure from additivity for the jointly exposed categories (Phase and Occupation Risk) on the prevalence odds scale.

[d] 95% CI for RERI estimated using Hosmer and Lemeshow.[10]

[e] LRT, likelihood ratio test for the multiplicative interaction calculated using nested models ($p < 0.20$, comparing model fit of two models with and without the multiplicative interaction term).

Expected estimate to observe under completely additivity:

Stay-at-home/Phase I: $\text{aPOR}_{01} - \text{aPOR}_{10} + \text{aPOR}_{00} = 0.76\text{-}0.41 + 1.00 = 1.35$.

Phase II/Phase III: $\text{aPOR}_{01} - \text{aPOR}_{10} + \text{aPOR}_{00} = 2.24 - 1.71 + 1.00 = 1.53$.

Expected estimate to observe under completely multiplicativity:

Stay-at-home/Phase I: $\text{aPOR}_{01} \times \text{aPOR10} = 0.76 \times 0.41 = 0.31$.

Phase II/Phase III: $\text{aPOR}_{01} \times \text{aPOR}_{10} = 0.76 \times 1.71 = 1.30$.

Ratio of aPORs:

Stay-at-home/Phase I: What we observed for the essential workers during a Stay-at-Home/Phase I order is 13.59 times more than multiplicative.

Phase II/Phase III: What we observed for the essential workers during a Phase II/Phase III is 1.73 times more than multiplicative.

been recognized.[16] Individuals in these professions are inherently at risk for exposure to SARS-CoV-2 through prolonged direct contact to patients[17] and/or other employees,[5] crowded working conditions,[16] lack of the availability of personal protective equipment (PPE), and poor ventilation.[9] Although we observed an increased prevalence odds for all essential occupations, the majority (74%) of essential employees in our study were in nonhealthcare professions. In the United States, federal regulations require healthcare professionals to receive annual PPE training focused on the prevention of transmissible diseases.[18] However, in nonhealthcare essential professions PPE is not universal, but if annual PPE training is required, it usually stresses the prevention of exposure to hazardous substances and/or materials.[19] Thus, we hypothesize the magnified SARS-CoV-2 prevalence among nonhealthcare essential employees was in part driven by work environments and safety practices not necessarily designed to mitigate infectious-disease transmission. In a cross-sectional occupational study in Italy, 41 nonhealthcare workplaces completed surveys on organizational changes made in response to SARS-CoV-2 pandemic, suggesting not all employers made changes to the domains of social distancing, disinfection, and personal protective equipment training.[20] Given the inherent efficiency of SARS-CoV-2 transmission, the emergence of new SARS-CoV-2 variants capable of even greater transmission as well as immune evasion, and ongoing threats posed by other emerging pathogens, it is vital for employers when vaccination is not available and/or not as effective, to implement and enforce public health interventions to protect employees and prevent infection spread within these establishments. These include but are not limited to the following interventions: universal masking, physical distancing, proper ventilation, barring symptomatic individuals from the workplace, disinfection of work environments, and provision of PPE and supplies for hand hygiene.

5 | LIMITATIONS

Study limitations include the potential for a lack of generalizability as we used a single-center cohort of convenience sampling. In addition, SARS-CoV-2 prevalence and mitigation strategies vary by jurisdiction.[21] Thus, our findings may not be applicable to other regions outside of Metropolitan Nashville, Tennessee. Our analysis was restricted to assessing the prevalence of effects within phases and does not reflect the incidence of SARS-CoV-2 within phase implementation in Nashville, Tennessee. We were unable to measure exposure intensity nor time incurred by persons of essential occupations and their adherence to mitigation strategies. Person-to-person interactions were not measured or assessed in this study. Additionally, self-selection bias may have occurred if persons with a higher risk for severe COVID-19 sought clinical testing or health-conscious individuals were more likely to participate in our study. We did not find a persisting association as restrictions were relaxed in Phase II/III for essential occupations compared to nonessential occupations during the pre-COVID-era. We posit this may be attributed to lower incidence within our community, less testing being performed, or small sample sizes.

6 | CONCLUSIONS

Our findings suggest that community closures for non-essential occupations can be an effective mitigation strategy to reduce SARS-CoV-2 infection incidence when a vaccine or other pharmaceutical interventions are not broadly available. However, the essential workforce remains at risk of SARS-CoV-2 infection (and presumably onward transmission to other susceptible individuals), and sustained public health interventions targeting both essential and nonessential job sectors may be critical to reducing infection during periods when community restrictions are eased.

AUTHOR CONTRIBUTIONS

Danielle A. Rankin: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; validation; visualization; writing—original draft; writing—review & editing. **Ahmad Yanis**: Investigation; writing—original draft; writing—review & editing. **Zaid Haddadin**: Writing—review & editing. **Rana Talj**: Investigation; project administration; writing—review & editing. **Kailee N. Fernandez**: Investigation; project administration; writing—review & editing. **Sean M. Bloos**: Data curation; writing—review & editing. **Anna Stahl**: Data curation; formal analysis; validation; writing—review & editing. **Wenying Gu**: Data curation; writing—review & editing. **Janet Nicotera**: Investigation; project administration; writing—review & editing. **Harrison L. Howe**: Data curation; investigation; writing—review & editing. **Seifein Salib**: Investigation; writing—review & editing. **Nikhil K. Khankari**: Conceptualization; formal analysis; methodology; supervision; validation; writing—original draft; writing—review & editing. **Natasha Halasa**: Conceptualization; project administration; supervision; writing—original draft; writing—review & editing.

ACKNOWLEDGEMENTS

The authors would like to acknowledge and thank the State of Tennessee Department of Health, Division of Laboratory Services, with specific thanks to Dr. Richard Steece, Dr. Kara Levinson, Lindsay Jolly, and the serology section for performing SARS-CoV-2 antibody testing on study participants. In addition, we would like to thank all of the individuals who have participated in our research study, COPE (COVID, Outbreak, Pandemic, Exploration). Vanderbilt University Medical Center, Division of Pediatrics, Vanderbilt University Dance Marathon Fund, National Center for Advancing Translational Sciences (grant number UL1TR000445). Danielle A. Rankin and Dr. Leigh Howard are supported by the National Institutes of Health (award numbers TL1TR002244, DAR; 1K23AI141621, LMH). Neither the National Center for Advancing Translational Sciences nor the National Institutes of Health had a role in the design or conduct of the study: collection, management, analysis, and interpretation of the

data; review and approval of the manuscript; or decision to submit the manuscript for publication.

CONFLICTS OF INTEREST

Natasha Halasa, MD, MPH receives grant support from Sanofi, Quidel, and speaker compensation from an education grant supported by Genentech. Sanofi also donated vaccines and influenza antibody testing for influenza vaccine trial. Sanofi, Quidel, nor Genetech had a role in the design or conduct of the study, collection, management, analysis, and interpretation of the data; review and approval of the manuscript; or decision to submit the manuscript for publication. All other authors declare no conflicts of interest.

TRANSPARENCY STATEMENT

Danielle Rankin affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Danielle A. Rankin http://orcid.org/0000-0003-3018-3373

REFERENCES

1. Lyu W, Wehby GL. Comparison of estimated rates of coronavirus disease 2019 (COVID-19) in Border Counties in Iowa without a stay-at-home order and border counties in Illinois with a stay-at-home order. *JAMA Netw Open*. 2020;3(5):e2011102.
2. County MPHDND. Safer at home order. 2020. Accessed June 28, 2021. https://www.asafenashville.org/wp-content/uploads/2020/04/Amended-and-Restated-ORDER-3-FINAL.pdf
3. Tennessee So. Executive Order by the Governor No. 22. 2020. Accessed June 28, 2021. https://publications.tnsosfiles.com/pub/execorders/exec-orders-lee22.pdf
4. Legislatures NCoS. COVID-19: Essential workers in the states. 2021. Accessed June 28, 2021. https://www.ncsl.org/research/labor-and-employment/covid-19-essential-workers-in-the-states.aspx
5. CDC. Essential Services and Critical Infrastructure. 2021. Accessed June 28, 2021. https://www.cdc.gov/coronavirus/2019-ncov/community/workplaces-businesses/essential-services.html
6. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap): a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377-381.
7. County MPHDND. Public Health Orders. 2020. Accessed June 28, 2021. https://www.asafenashville.org/public-health-orders/
8. Tennessee So. Executive Orders of Governor Bill Lee. 2020. Accessed June 28, 2021. https://sos.tn.gov/products/division-publications/executive-orders-governor-bill-lee
9. Michaels D, Wagner GR. Occupational Safety and Health Administration (OSHA) and worker safety during the COVID-19 Pandemic. *JAMA*. 2020;324:1389.
10. Hosmer DW, Lemeshow S. Confidence interval estimation of interaction. *Epidemiology*. 1992;3(5):452-456.
11. Gallaway MS, Rigler J, Robinson S, et al. Trends in COVID-19 incidence after implementation of mitigation measures-Arizona, January 22-August 7, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(40):1460-1463.
12. Jones KE, Patel NG, Levy MA, et al. Global trends in emerging infectious diseases. *Nature*. 2008;451(7181):990-993.
13. Markel H, Lipman HB, Navarro JA, et al. Nonpharmaceutical interventions implemented by US cities during the 1918-1919 influenza pandemic. *JAMA*. 2007;298(6):644-654.
14. Qualls N, Levitt A, Kanade N, et al. Community mitigation guidelines to prevent pandemic influenza - United States, 2017. *MMWR Recomm Rep*. 2017;66(1):1-34.
15. Gadermann AC, Thomson KC, Richardson CG, et al. Examining the impacts of the COVID-19 pandemic on family mental health in Canada: findings from a national cross-sectional study. *BMJ Open*. 2021;11(1):e042871.
16. Dyal JW, Grant MP, Broadwater K, et al. COVID-19 among workers in meat and poultry processing facilities-19 States, April 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69:18.
17. Groenewold MR, Burrer SL, Ahmed F, Uzicanin A, Free H, Luckhaupt SE. Increases in health-related workplace absenteeism among workers in essential critical infrastructure occupations during the COVID-19 pandemic-United States, March-April 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(27):853-858.
18. CDC. Occupational Infection Prevention and Control: Education and Training. 2019. Accessed June 28, 2021. https://www.cdc.gov/infectioncontrol/guidelines/healthcare-personnel/training.html
19. (OSHA) OSaHA. Personal Protective Equipment. 2004. Accessed June 28, 2021. https://www.osha.gov/sites/default/files/publications/osha3151.pdf
20. Garzillo EM, Monaco MGL, Spacone A, Inglese E, Lamberti M, Pompei D. SARS-CoV-2 emergency in the workplace: are companies ready to protect their workers? A cross-sectional survey. *Int J Occup Saf Ergon*. 2020:1-8.
21. Sanche S, Lin YT, Xu C, Romero-Severson E, Hengartner N, Ke R. High contagiousness and rapid spread of severe acute respiratory syndrome coronavirus 2. *Emerg Infect Dis*. 2020;26(7):1470-1477.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Rankin DA, Yanis A, Haddadin Z, et al. The impact of community closures among nonessential and essential workers, Nashville, Tennessee: A cross-sectional study. *Health Sci. Rep*. 2022;5:e658. doi:10.1002/hsr2.658