

Anxiety and depression among public health workers during the COVID-19 pandemic

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ABSTRACT

Introduction: *The public health workforce plays an essential role in the response to disasters and emergencies. Little is known about the prevalence of anxiety and depression among the public health emergency preparedness workforce responding to COVID-19 or the potential for social support to protect public health workers from adverse outcomes.*

Methods: *A cross-sectional online survey was conducted among a sample of the public health workforce participating in the response to COVID-19. Prevalence ratios (PRs) and 95% confidence intervals (CIs) were calculated using Poisson regression with robust standard errors.*

Results: *Overall, 39.6 percent (140 of 345) of respondents reported anxiety and 29.4 percent (104 of 345) reported depression. The prevalence of anxiety and depression was higher among those who worked more hours (PR = 1.5; 95% CI: 1.2, 2.0) and days (PR = 1.3; 95% CI: 0.9, 1.8) per week. Anxiety was 40 percent more prevalent (PR = 1.4; 95% CI: 0.8, 2.4) among those with between 1 and 4 years of work experience, while depression was 60 percent more prevalent (PR = 1.6; 95% CI: 0.8, 3.1) among those with 5 to 9 years of experience. Compared to those with a bachelor's degree, those with a master's degree reported 30 percent more anxiety (PR = 1.3;*

95% CI: 0.9, 1.9). Having at least three sources of social support related to comfort and caring reduced the prevalence of depression among those working the most hours per week (PR = 1.5; 1.1, 2.3 compared to PR = 2.0; 95% CI: 0.9, 4.5). Economic and practical support was more consistently protective, with a reduced prevalence of anxiety and depression among those working the most hours per week, days per week, and those with more education when at least three sources of support were reported.

Discussion: *Anxiety and depression symptoms and diagnoses have been associated with burnout and suicide among frontline disaster responders. The public health workforce on the frontlines of the COVID-19 emergency response has high rates of depression and anxiety, which must be addressed through robust individual- and organizational-level supports.*

Key words: *COVID-19; mental health; anxiety; depression; emergency response*

INTRODUCTION

Public health agencies and their workforces have long played essential roles in responding to disasters and emergencies. Public health nurses staff evacuation shelters providing medical treatment and preventing outbreaks of disease.¹ Environmental health

staff monitor the safety of public and private water systems, inspect facilities like restaurants and hotels before they reopen, and conduct environmental health assessments.² Epidemiologists establish public health surveillance systems to monitor health, identify outbreaks, and collect and analyze disaster data.³

In the late 1990s, the focus of public health preparedness activities shifted from national security and biodefense toward the development of a more robust public health emergency preparedness and response infrastructure, which included the expansion of the public health preparedness workforce at the federal, state, and local levels.⁴⁻⁶ The attacks of September 11, 2001, provided the impetus to further expand public health emergency preparedness and response systems, with funding increasing from \$99 million authorized by the Public Health Threats and Emergencies Act of 2000 to more than \$940 million in 2002.⁷ Even with cuts to funding and workforce reductions brought about by the 2008 financial crisis,^{8,9} by 2017, most Public Health Emergency Preparedness (PHEP)-funded jurisdictions reported high levels of capability in medical countermeasures and mitigation, although critical gaps remained in planning, personnel, and funding.^{7,10}

Although public health plays critical roles in the response to emergencies, there has been little research on the impacts of the COVID-19 response on the mental health of the public health workforce. Most research has focused on the mental health impacts of the COVID-19 response among frontline healthcare workers and medical responders.¹¹⁻¹⁸ However, the extent and duration of the COVID-19 pandemic, and the critical role being played by the PHEP workforce as part of the emergency response, highlights the potential for increased threats to the mental health of public health workers.¹⁹ Understanding the prevalence of anxiety and depression among public health workers is particularly important because previous research has linked both symptoms and diagnoses of anxiety and depression to burnout and suicidal behavior among frontline disaster responders.²⁰

One way to mitigate both the prevalence and the future impacts of mental health conditions associated with emergency response may be access to higher

levels of social support. Social support is one of the factors most reliably associated with fewer negative and more positive psychological outcomes in disasters.²¹ Social support from various sources, including family, friends, and place of employment can reduce psychological risk and increase resilience among disaster and medical responders.²² However, little is known about how social support-related circumstances may affect the prevalence of psychological outcomes like anxiety and depression, specifically among public health workers.

The goal of this study was to document the prevalence of anxiety and depression among a sample of the public health workforce responding to the COVID-19 pandemic in the United States and to identify sources of social support that may potentially be protective for sequelae such as burnout and suicide as the pandemic continues.

METHODS

A cross-sectional survey was developed based on published scales to measure anxiety, depression, and other impacts of COVID-19 on the public health workforce using the web-based Qualtrics platform (Provo, UT). The survey was pilot-tested with public health staff at a large US city health department and revised based on feedback. A link to the final survey was shared with members of professional groups, via professional networks, and on social media via a vetted group with documented academic training and work experience in public health.

The survey included 45 questions across three themes: sociodemographic characteristics, personal well-being, including physical and mental health status (generalized anxiety and depression), and career plans. Generalized anxiety disorder (GAD) was assessed using a 7-item (GAD-7) scale,²³ and depressive disorder using the two-item Patient Health Questionnaire (PHQ-2) subscale.²⁴ Social support was assessed with two questions that asked about available sources for support for comfort and caring and for economic support and practical problem-solving (none, spouse/partner, other family members, friends, relatives, colleagues, companies, official or semi-official organizations such as parties, leagues,

and unions, unofficial organizations such as religious organizations or social groups, and other).

Data were downloaded from Qualtrics and analyzed using Stata Version 15 (College Station, TX). Outcomes of interest, ie, anxiety and depression, were stratified by gender, age, race/ethnicity, marital status, household size, work hours, years of experience in public health, public health work sector, and education level. To avoid the potential of overestimating prevalent outcomes with odds ratios, we reported prevalence ratios (PRs) and 95% confidence intervals (CIs) calculated using Poisson regression with robust standard errors.²⁵ The survey and related materials were reviewed by an Institutional Review Board and determined to be exempt.

RESULTS

Between August 23, 2020, and January 6, 2021, 354 respondents from 35 US states and the District of Columbia completed the survey. Most respondents

were currently working in public health practice (79.6 percent). The majority were female (83.3 percent), White non-Hispanic (76.2 percent), and under the age of 40 (57.9 percent). Compared to the US public health workforce as a whole, the respondents were more likely to be female (83.3 percent compared to 77 percent), White (76.2 percent compared to 57.2 percent), and younger (overall workforce mean age = 47 years).²⁶

Anxiety and depression among public health workers

Overall, 39.6 percent (140 of 345) of respondents reported anxiety and 29.4 percent (104 of 345) reported depression. Anxiety and depression were more prevalent among some groups of respondents (Table 1). Respondents with 1–4 years of work experience were 1.4 times (95% CI: 0.08, 2.4) as likely to report anxiety than those with <1 year of experience. Prevalence of anxiety was 30 percent higher (PR = 1.3; 95% CI: .09, 1.9) among those with a master's degree

Table 1. Risk factors for anxiety and depression related to the COVID-19 pandemic response: United States, August 23–January 6, 2021 (N = 354)

Characteristic/experience	Prevalence ratio (95% CI)	
	Anxiety	Depression
Gender		
Female	Ref	Ref
Male	0.9 (0.7–1.3)	0.8 (0.5–1.2)
Age (years)		
18–29	Ref	Ref
30–39	0.9 (0.6–1.2)	0.8 (0.6–1.2)
40–49	0.9 (0.7–1.3)	0.8 (0.5–1.3)
50–64	0.7 (0.4–1.0)	0.7 (0.4–1.2)
65+	0.2 (0.04–1.5)	^a
Race/ethnicity		
White, non-Hispanic	Ref	Ref
Asian, non-Hispanic	1.0 (0.6–1.6)	0.3 (0.5–1.9)
Black, non-Hispanic	0.2 (0.04–1.5)	0.3 (0.05–2.0)
Hispanic, any race(s)	1.1 (0.8–1.7)	1.2 (0.7–2.0)
Other race or multiple races, non-Hispanic	1.1 (0.5–2.1)	0.6 (0.2–2.0)
Marital status		
Now married/in partnership	Ref	Ref
Never married	1.1 (0.8–1.4)	1.0 (0.7–1.5)
Other ^p	0.8 (0.5–1.5)	0.9 (0.5–1.7)

Table 1. Risk factors for anxiety and depression related to the COVID-19 pandemic response: United States, August 23–January 6, 2021 (N = 354) (continued)

Characteristic/experience	Prevalence ratio (95% CI)	
	Anxiety	Depression
1	Ref	Ref
2	0.9 (0.7–1.3)	0.9 (0.6–1.3)
3	0.8 (0.5–1.2)	0.7 (0.4–1.2)
4+	0.7 (0.5–1.1)	0.7 (0.4–1.1)
Hours worked/week		
≤50 hours per week	Ref	Ref
>50 hours per week	1.5 (1.2–2.0)	1.6 (1.2–2.3)
Days worked/week		
≤5 days per week	Ref	Ref
>5 days per week	1.3 (0.9–1.8)	1.2 (0.8–1.8)
Experience (years)		
<1	Ref	Ref
1–4	1.4 (0.8–2.4)	1.1 (0.5–2.2)
5–9	1.1 (0.7–2.0)	1.6 (0.8–3.1)
10–14	1.0 (0.5–1.8)	1.1 (0.5–2.3)
15+	1.2 (0.7–2.1)	1.2 (0.6–2.4)
Public health sector		
Public health practice	Ref	Ref
Academic	0.8 (0.5–1.3)	0.7 (0.3–1.3)
Other ^c	0.6 (0.3–1.1)	0.9 (0.5–1.6)
Education		
≤Bachelors	Ref	Ref
Masters	1.3 (0.9–1.9)	0.9 (0.6–1.4)
Doctoral	1.1 (0.7–1.7)	0.6 (0.3–1.0)

Notes: COVID-19 = coronavirus disease 2019; CI = confidence interval; Anxiety = respondents who scored ≥10 on the generalized anxiety disorder—7 scale; Depression = respondents who scored ≥3 on the patient health questionnaire—2 question subscale for depressive disorder.

^aInsufficient data for analysis.
^bIncludes widowed, divorced, and separated.
^cIncludes clinical setting, nonacademic research, and nonprofit setting.

compared with those with a bachelor’s degree or less. The prevalence of depression was 60 percent higher (PR = 1.6; 95% CI: .08, 3.1) among those with 6–10 years of work experience compared to those with <1 year of experience. Hours worked per week was consistently associated with a higher prevalence of anxiety and depression, with those working >50 hours per week reporting 1.5 (95% CI: 1.2, 2.0) and 1.6 (95% CI: 1.2, 2.3) times the anxiety and depression as those working 50 hours or less per week, respectively. Days

worked per week was similar, with 30 percent more anxiety (PR = 1.3; 95% CI: .09, 1.8) and 20 percent more depression (PR = 1.2; 95% CI: .08, 1.8) among those working more than 5 days per week compared with those working 5 or fewer days per week.

Social support as a mediator of anxiety and depression

Among the groups at highest risk for increased anxiety and depression, we assessed whether having

a greater overall number of sources of social support was protective. Among those working more than 50 hours per week with three or more sources of comfort and caring, anxiety (PR = 1.3; 95% CI: 0.9, 1.8 versus PR = 2.0; 1.3, 2.9) and depression (PR = 1.4; 95% CI: 0.9, 2.2 versus PR = 1.9; 1.2, 3.2) were less prevalent (Table 2). Among those with 5 to 9 years of work experience, more sources of comfort and caring reduced the prevalence of anxiety (PR = 1.1; 95% CI: 0.5, 2.6 versus PR = 2.1; 0.8, 5.5).

Economic and practical social support was more consistently protective against anxiety and depression. Among respondents working the most hours per week, having three or more sources of economic or practical support reduced anxiety (PR = 0.7; 95% CI: 0.4, 1.3 versus PR = 1.9; 1.4, 2.6) and depression (PR = 0.9; 95% CI: 0.5, 1.8 versus PR = 1.9; 1.3, 2.8)

(Table 3). This protective effect was also seen among those working the most days per week. Respondents with graduate-level education and three or more sources of economic or practical support also reported reduction in anxiety (PR = 0.7; 95% CI: 0.4, 1.3 versus PR = 1.6; 1.0, 2.8) and depression (PR = 0.6; 95% CI: 0.5, 1.3 versus PR = 1.0; 0.6, 1.7) compared with those with a master's degree.

DISCUSSION

Since the terrorist attacks of September 11, 2001, and the subsequent anthrax attacks, the role of the public health workforce in emergency response has expanded to include incident management, medical countermeasures, biosurveillance, and more.²⁷ This is particularly true during a biological emergency, such as an intentional attack, or the emergence or

Table 2. Public health workforce anxiety and depression and number and sources of social support, comfort, and caring: United States, August 23–January 6, 2021 (N = 354)

	Anxiety		Depression	
	Prevalence ratio (95% CI)		Prevalence ratio (95% CI)	
	<3 Sources of social support	3+ Sources of social support	<3 Sources of social support	3+ Sources of social support
Hours (N = 354)				
≤50 hours per week	Ref	Ref	Ref	Ref
>50 hours per week	2.0 (1.3–2.9)	1.3 (0.9–1.8)	1.9 (1.2–3.2)	1.4 (0.9–2.2)
Days (N = 274)				
≤5 days per week	Ref	Ref	Ref	Ref
>5 days per week	1.2 (0.7–1.9)	1.3 (0.9–2.1)	0.9 (0.5–1.6)	1.5 (0.9–2.5)
Experience (years; N = 353)				
<1	Ref	Ref	Ref	Ref
1–4 w	1.4 (0.7–2.9)	1.3 (0.5–3.0)	1.4 (0.5–3.9)	0.8 (0.3–1.9)
5–9	1.0 (0.4–2.1)	1.2 (0.5–2.8)	2.1 (0.8–5.5)	1.1 (0.5–2.6)
10–14	0.8 (0.3–2.0)	1.0 (0.4–2.6)	0.9 (0.2–3.0)	1.0 (0.4–2.5)
15+	1.2 (0.6–2.5)	1.2 (0.5–2.9)	1.6 (0.6–4.4)	0.8 (0.3–2.0)
Education (N = 354)				
≤Bachelors	Ref	Ref	Ref	Ref
Masters	1.3 (0.7–2.4)	1.3 (0.8–2.2)	1.1 (0.6–2.3)	0.8 (0.5–1.3)
Doctoral	1.0 (0.5–2.0)	1.2 (0.7–2.2)	0.5 (0.2–1.4)	0.7 (0.4–1.3)

Notes: COVID-19 = coronavirus disease 2019; CI = confidence interval; Anxiety = respondents who scored ≥10 on the generalized anxiety disorder—7 scale; Depression = respondents who scored ≥3 on the patient health questionnaire—2 question subscale for depressive disorder.

^aInsufficient data for analysis.

Table 3. Public health workforce anxiety and depression and number and sources of social support, economic support, and practical problem-solving: United States, August 23–January 6, 2021 (N = 354)

	Anxiety		Depression	
	Prevalence ratio (95% CI)		Prevalence ratio (95% CI)	
	<3 Sources of social support	3+ Sources of social support	<3 Sources of social support	3+ Sources of social support
Hours (N = 354)				
≤50 hours per week	Ref	Ref	Ref	Ref
>50 hours per week	1.9 (1.4–2.6)	0.7 (0.4–1.3)	1.9 (1.3–2.8)	0.9 (0.5–1.8)
Days (N = 274)				
≤5 days per week	Ref	Ref	Ref	Ref
>5 days per week	1.5 (1.1–2.1)	0.8 (0.4–1.5)	1.2 (0.8–1.9)	1.1 (0.5–2.5)
Experience (years; N = 353)				
<1	Ref	a	Ref	a
1–4	1.4 (0.7–2.6)		1.0 (0.5–2.2)	
5–9	1.1 (0.6–2.2)		1.5 (0.8–3.2)	
10–14	1.3 (0.7–2.6)		1.1 (0.5–2.4)	
15+	1.3 (0.7–2.3)		1.2 (0.6–2.6)	
Education (N = 354)				
≤Bachelors	Ref	Ref	Ref	Ref
Masters	1.6 (1.0–2.8)	0.7 (0.4–1.3)	1.0 (0.6–1.7)	0.6 (0.5–1.3)
Doctoral	1.3 (0.7–2.4)	0.7 (0.3–1.5)	0.7 (0.4–1.3)	0.4 (0.1–1.1)

Notes: COVID-19 = coronavirus disease 2019; CI = confidence interval; anxiety = respondents who scored ≥10 on the generalized anxiety disorder – 7 scale; depression = respondents who scored ≥3 on the patient health questionnaire – 2 question subscale for depressive disorder.

^aInsignificant data for analysis.

re-emergence of an infectious disease such as severe acute respiratory syndrome, H1N1 novel influenza A, or COVID-19. For an emergency like a pandemic, in addition to fulfilling typical emergency response roles, public health staff must also take on increasing workloads during a time of high uncertainty about the characteristics of the pathogen causing the pandemic, as well as the anxiety of becoming infected themselves.²⁸ Many workers must take on additional, often unfamiliar, roles or functions as part of the “all hands on deck” approach to response.²⁹

Higher levels of social support have been consistently associated with a lower risk of mental health outcomes among disaster responders.^{21,30,31} However, the effectiveness of social support depends on a variety of factors, including the source of the support³² and the length of the response.³³ In these data, collected

approximately 5–10 months into the response to an unprecedented pandemic, social support was protective for some groups. Factors such as school and business closures, which have been widespread during COVID-19, likely explain why stronger and more consistent protection against anxiety and depression in this sample was associated with economic and practical support as compared to comfort and caring support. Policy solutions to this need for economic and practical support, such as childcare subsidies,³⁴ supplemental food programs,³⁵ and job protections,³⁶ have all been proposed and are needed now to address urgent needs and prepare for the future.

This study has several important limitations. Compared to 2017 estimates of the US governmental public health workforce, female, White, and respondents under 40 were over-represented in our sample.³⁷

Compared to the size of the overall public health workforce, the sample size is small. It is, however, comparable to similar studies on anxiety, depression, and other mental health sequelae among emergency responders. The response to the COVID-19 pandemic is ongoing, and the added pressures of developing and implementing vaccination programs would, for the most part, have occurred after these data were collected. Therefore, we cannot assess the trajectory of the prevalence of anxiety and depression. However, these data may serve as a starting point to describe the anxiety and depression being experienced by the public health workforce and can, in the future, be compared with similar research focused on other job sectors of emergency responders, eg, emergency medical technicians, paramedics, firefighters, law enforcement.

The United States began its response to the COVID-19 pandemic with a deficit of 250,000 public health workers and budgets for public health emergency preparedness that had been steadily reduced each year since 2008.^{8,9,38-40} Like many other governmental agencies and public services, the future of the public health workforce is also threatened by upcoming retirements, uncompetitive pay, and few opportunities for advancement.⁴⁰ Looking back over the last two decades, while COVID-19 is unique in its scope and duration, it is one of many recent emergencies precipitated by an emerging or re-emerging infectious disease that required a robust public health emergency response. Urgent interventions, and long-term policy changes, are needed if the public health workforce is to robustly respond to public health emergencies of the future.

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REFERENCES

1. Rivera-Rodriguez E: *Role of the Nurse during Disaster Preparedness: A Systematic Literature Review and Application to Public Health Nurses* [doctoral dissertation], Walden University, Minneapolis, MN, USA. 2017. <https://scholarworks.waldenu.edu/cgi/viewcontent.cgi?article=5353&context=dissertations>.
2. McDavid K, Miguel Cruz MP: Environmental health shelter assessments: Using tools to protect occupants after disasters. *J Environ Health*. 2019 Dec 1; 82(5): 32-33.
3. Malilay J, Heumann M, Perrotta D, et al.: The role of applied epidemiology methods in the disaster management cycle. *Am J Public Health*. 2014 Nov; 104(11): 2092-3102.
4. McDade JE, Franz D: Bioterrorism as a public health threat. *Emerg Infect Dis*. 1998 Jul; 4(3): 493.
5. Henderson DA: Bioterrorism as a public health threat. *Emerg Infect Dis*. 1998 Jul; 4(3): 488.
6. Henderson DA: The looming threat of bioterrorism. *Science*. 1999 Feb 26; 283(5406): 1279-1282.
7. Watson CR, Watson M, Sell TK: Public health preparedness funding: Key programs and trends from 2001 to 2017. *Am J Public Health*. 2017; 107(S2): S165-S167.
8. Association of State and Territorial Health Officials: New data on state health agencies show shrinking workforce and decreased funding leading up to COVID-19 pandemic, 2020.
9. National Association of County and City Health Officials: Changes in local health department workforce and finance capacity since 2008, 2019.
10. Murthy BP, Molinari NAM, LeBlanc TT, et al.: Progress in public health emergency preparedness—United States, 2001-2016. *Am J Public Health*. 2017; 107(S2): S180-S185.
11. Naushad VA, Bierens JJ, Nishan KP, et al.: A systematic review of the impact of disaster on the mental health of medical responders. *Prehospital Disaster Med*. 2019; 34(6): 632-643.
12. Cai H, Tu B, Ma J, et al.: Psychological impact and coping strategies of frontline medical staff in Hunan between January and March 2020 during the outbreak of coronavirus disease 2019 (COVID-19) in Hubei, China. *Med Sci Monit*. 2020; 26: e924171.
13. Felice C, Di Tanna GL, Zanus G, et al.: Impact of COVID-19 outbreak on healthcare workers in Italy: Results from a National E-Survey. *J Community Health*. 2020; 45(4): 675-683.
14. García-Fernández L, Romero-Ferreiro V, López-Roldán PD, et al.: Mental health impact of COVID-19 pandemic on Spanish healthcare workers. *Psychol Med*. 2020: 1-3.
15. Lai J, Ma S, Wang Y, et al.: Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. *JAMA Netw Open*. 2020; 3(3): e203976.
16. Preti E, Di Mattei V, Perego G, et al.: The psychological impact of epidemic and pandemic outbreaks on healthcare workers: Rapid review of the evidence. *Curr Psychiatry Rep*. 2020; 22(8): 43.
17. Stuijzand S, Deforges C, Sandoz V, et al.: Psychological impact of an epidemic/pandemic on the mental health of healthcare professionals: A rapid review. *BMC Public Health*. 2020; 20(1): 1230.
18. Barello S, Palamenghi L, Graffigna G: Burnout and somatic symptoms among frontline healthcare professionals at the peak of the Italian COVID-19 pandemic. *Psychiatry Res*. 2020; 290: 113129.
19. Vo, T: A practical guide for frontline workers during COVID-19: Kolcaba's comfort theory. *J Patient Exper*. 2020; 7(5): 635-639. DOI:10.1177/2374373520968392.
20. Kolves K, Kolves KE, De Leo D: Natural disasters and suicidal behaviors: A systematic literature review. *J Affective Disord*. 2013; 146: 1-14.

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21. Guilaran J, de Terte I, Kaniasty K, et al.: Psychological outcomes in disaster responders: A systematic review and meta-analysis on the effect of social support. *Int J Disaster Risk Sci.* 2018; 9(3): 344-358.
22. Brooks SK, Dunn R, Amlôt R, et al.: Social and occupational factors associated with psychological distress and disorder among disaster responders: A systematic review. *BMC Psychol.* 2016; 4: 18. DOI:10.1186/s40359-016-0120-9.
23. Spitzer RL, Kroenke K, Williams JB, et al.: A brief measure for assessing generalized anxiety disorder: The GAD-7. *Arch Intern Med.* 2006; 166(10): 1092-1097.
24. Arroll B, Goodyear-Smith F, Crengle S, et al.: Validation of PHQ-2 and PHQ-9 to screen for major depression in the primary care population. *Ann Fam Med.* 2010; 8(4): 348-353.
25. Davies HT, Crombie IK, Tavakoli M: When can odds ratios mislead? *BMJ.* 1998; 316(7136): 989-991. DOI:10.1136/bmj.316.7136.989.
26. Center for State and Local Government Excellence: *How does the public health workforce compare with the broader public sector?* 2020.
27. Centers for Disease Control and Prevention: CDC's public health emergency preparedness program: Every response is local, 2020. Available at <https://www.cdc.gov/cpr/whatwedo/phep.htm>. Accessed February 26, 2021.
28. Vinck L, Isken L, Hooiveld M, et al.: Impact of the 2009 influenza A (H1N1) pandemic on public health workers in the Netherlands. *Eurosurveillance.* 2011; 16(7): 19793.
29. Kintziger KW, Stone KW, Jagger MA, et al.: What's left undone: The impact of the COVID-19 response on the provision of other public health services in the US Under review at *BMC Public Health*. DOI: 10.21203/rs.3.rs-215247/v1.
30. Goldmann E, Galea S: Mental health consequences of disasters. *Annu Rev Public Health.* 2014; 35: 169-183.
31. Prati G, Pietrantonio L: The relation of perceived and received social support to mental health among first responders: A meta-analytic review. *J Commun Psychol.* 2010; 38(3): 403-417.
32. Halbesleben JRB: Sources of social support and burnout: A meta-analytic test of the conservation of resources model. *J Appl Psychol.* 2006; 91(5): 1134-1145.
33. Kaniasty K, Norris FH: Mobilization and deterioration of social support following natural disasters. *Curr Directions Psychol Sci.* 1995; 4(3): 94-98.
34. Chin ET, Huynh BQ, Lo NC, et al.: Projected geographic disparities in healthcare worker absenteeism from COVID-19 school closures and the economic feasibility of child care subsidies: A simulation study. *BMC Med.* 2020; 18(1): 1-8.
35. Adams G, Todd M: Meeting the school-age child care needs of working parents facing COVID-19 distance learning: Policy options to consider. *Urban Institute.* 2020.
36. Alon TM, Doepke M, Olmstead-Rumsey J, et al.: *The Impact of COVID-19 on Gender Equality* (No. w26947). National Bureau of Economic Research, 2020.
37. Bogaert K, Castrucci BC, Gould E, et al.: Changes in the state governmental public health workforce: Demographics and perceptions, 2014-2017. *J Publ Health Manage Pract: JPHMP.* 2019; 25 Suppl 2, Public Health Workforce Interests and Needs Survey 2017(2 Suppl): S58-S66.
38. McCoy SI, MacDonald PDM: Need to amplify health security? Fuse academia and practice. *Public Health Rep.* 2020: 33354920935075.
39. Wilson RT, Troisi CL, Gary-Webb TL: A deficit of more than 250,000 public health workers is no way to fight Covid-19. Available at <https://www.statnews.com/2020/04/05/deficit-public-health-workers-no-way-to-fight-covid-19/>. Published 2020. Accessed June 25, 2020.
40. Leider JP, Coronado F, Beck AJ, et al.: Reconciling supply and demand for state and local public health staff in an era of retiring baby boomers. *Am J Prev Med.* 2018; 54(3): 334-340.