BMJ Open

Mental Wellbeing of Health Care Workers in Lusaka, Zambia During the COVID-19 Pandemic

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-069257
Article Type:	Original research
Date Submitted by the Author:	17-Oct-2022
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Keywords:	COVID-19, EPIDEMIOLOGY, HIV & AIDS < INFECTIOUS DISEASES, MENTAL HEALTH

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Mental Wellbeing of Health Care Workers in Lusaka, Zambia During the COVID-19 Pandemic

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Keywords: Health Care Workers, Depression, COVID-19, PHQ-9

Abstract

Objectives: We sought to assess mental health among HCWs in the context of COVID-19 across 24 health facilities in Lusaka Province, Zambia.

Methods: We implemented the, well-validated, Patient Health Questionnaire (PHQ-9) to assess depression through a cross-sectional study of HCWs recruited though convenience sampling during 11 August - 15 October 2020 during the second wave of the COVID-19 epidemic in Zambia. Potential participants were invited from 24 government-funded health facilities in Lusaka Province, Zambia. We used mixed-effects, adjusted Poisson regression to estimate the marginal probability of HCW experiencing depression that may warrant intervention (PHQ-9 score ≥5) by healthcare facility.

Results: We collected PHQ-9 survey responses from 713 professional and lay HCWs. Overall, 334 (46.8%, 95% CI: 43.1, .50.6%) HCWs recorded a PHQ-9 score ≥5, indicating the need for further screening and assessment for mental health disorders, as well as preventative interventions, to minimize the possibility of poor health outcomes. We identified significant heterogeneity across facilities and observed a greater proportion of HCWs in facilities providing COVID-19 testing and treatment services with symptoms of depression.

Conclusions: Mental wellbeing may be a concern for a large proportion of HCW in Zambia. Further work to understand the magnitude and etiologies of mental health disorders amongst HCW in the public sector is needed to design effective interventions to meet the need for mental health support.

BMJ Open Questions:

Strengths and Limitations of this study

- These data represent important insight regarding the state of mental wellness among a large sample of healthcare workers during a public health crisis in a resource limited setting.
- Mental wellness, like depression, is not documented well in resource limited settings and we measure here mental wellness in a high-risk group of healthcare workers during the COVID-19 pandemic.
- An important limitation is lack of data on demographics of healthcare worker respondents due to concern about stigma around mental wellness and potential to identify individuals given inclusion of clinics with small staff.
- We include a large number (N=24) of facilities to appreciate the heterogeneity in symptoms of depression among mental health in the sampled facilities in Lusaka Province of Zambia.

Introduction

Coronavirus disease 2019 (COVID-19) has caused substantial global health hardship and healthcare workers (HCWs) position on the frontlines of the public health response, places them at great risk for negative effects on health and wellbeing. In addition to excess occupational hazard of contracting COVID-19, their experience as care givers increases risk of developing mental health disorders such as anxiety, depression, trauma, insomnia, and stress, which may lead to poor physical and psychological wellbeing [1]. A healthy workforce is critical to effectively managing and mitigating COVID-19, as well as providing continuity of high-quality care for other chronic and acute health conditions [2, 3]. Even prior to COVID-19, countries in sub-Saharan Africa faced limited medical infrastructure, supplies, and an over-burdened workforce, which challenged the provision of quality healthcare [4, 5]. These challenges, along with pandemic-sensitive barriers such as limited access to personal protective equipment (PPE) further exacerbated HCW stress and vulnerability. While HCWs in resource limited settings have demonstrated resilience, poor mental health is likely to compromise their ability to make decisions**,** as well as impact patient interactions [6]. Mental health services, like other health resources, are limited, with few trained mental health providers[7]. Understanding mental health and wellbeing among HCWs can catalyze interventions to provide treatment and improve the healthcare facility environment for the HCWs and patients [7].

Several studies have been conducted to assess mental wellness impact of the pandemic amongst HCWs however, the majority of these studies focus on the continent of Asia and very little data is available for HCWs in Africa [8, 9]. Limited data from Kenya and Ethiopia provides evidence that the prevalence of mental disorders such as depression, insomnia and stress were higher among those HCWs caring for patients with COVID-19, or in areas of higher infection prevalence compared to those working with non-COVID-19 patients or less [1, 10-14]. The most prevalent reported mental health conditions among health care workers are depression, insomnia, and anxiety [15]. Characterization of the state of mental wellness during the COVID-19 pandemic in Sub-Saharan African countries among HCWs, specifically in Zambia remains incomplete [10, 16].

As part of a larger patient-centered care study, we collected facility-level measures to understand the context of care at 24 study sites. As a part of establishing care context we assessed mental health, specifically depression, using the nine item Patient Health Questionnaire (PHQ-9) in the

context of COVID-19 among HCWs in Lusaka Province, Zambia from 11 August 2020 to 15 October 2020 [17].

Methods

Setting

This cross-sectional study is nested within a larger study, Person Centered Public Health for HIV Treatment in Zambia (PCPH), a cluster-randomized trial to assess HIV care and outcomes running from August 2018 to November 2021 across 24 government-funded health facilities in Lusaka Province (Pan African Clinical Trial Registry number: PACTR202101847907585). All participating facilities offered HIV care services and varied in size and location. Facilities were assigned codes to protect the identity of the HCW participants. As a part of the PCPH package adaptation to the COVID-19 pandemic, we implemented the PHQ-9 to screen for presence and severity of depression. The PHQ-9 has been previously used in Zambia to screen for likelihood of depression [20], and has been validated in Tanzania and South Africa which are similar settings as Zambia [18, 19]. The PHQ-9 instrument was translated from English into Nyanja and Bemba, the most commonly spoken Zambian languages in Lusaka Province, where the survey was conducted [20].

Study Population

We developed a cohort of HCWs that primarily provide HIV care at one of the 24 health facilities in the PCPH study. This was done by compiling all HCW's contact details from the HCWs who had, at the time of the introduction of the PHQ-9 measure to the study, participated in the HCW survey component of the PCPH study. The PCPH sample was comprised of both professional and lay HCWs including nurses, pharmacists, treatment supporters, midwives, medical doctors, radiographers, and general workers. To augment participation in the PHQ-9 data collection, we expanded the PHQ-9 sample to include any HCW willing to participate and had ≥6 months working experience at the study facility. We informed the facility in-charge of the PHQ-9 study opportunity who communicated it to staff members.

Measurements

Trained study research assistants then visited the facility and discussed the study opportunity in-person with available staff members. Those who expressed interest were screened for eligibility, offered the opportunity to verbally consent and with immediate participation. Depending on the participant preference, the standard PHQ-9 survey was self-administered on paper or surveyor-administered by trained study research assistants in the participant's preferred language. Potentially identifying information such as age, sex, and HCW cadre were not collected from respondents to protect privacy.

Analysis

We followed the standard, 27-point scoring system for the PHQ-9 to identify participants with scores consistent with minimal (0-4), mild (5-9), moderate (10-14), moderately severe (15-19), and severe depression (20-27) [18]. Our main outcome was mild depression or great (PHQ-9 score >=5) as this level of depression warrants additional clinical follow-up. We developed frequency tables and used a bar graphs to illustrate the distribution of PHQ-9 scores by healthcare facility. We developed scatter plots of adjusted marginal probability with 95% confidence intervals to illustrate the probability that a HCW will have a PHQ-9 score ≥5 by healthcare facility. We used mixed effects Poisson regression to estimate prevalence ratios for those with mild depression allowing random effects at the facility level and measured fixed effects for month of survey and clinic size category. Facilities were categorized by client population estimates as small (<40,000 clients), medium (40,000-100,000 clients), and large (>100,000 clients).

Patient and Public Involvement

The parent study, focused primarily on improving the patient experience at routine clinic visits through HCW mentorship and support including assessments of mental wellness through administration of the PHQ-9 tool, the results of which are captured here. The research approach and content is based on previous research, human-centered design workshops, and stakeholder collaborations [21-27]. We invited HCWs from each of the study facilities to attend a human-centered design workshop with expert direction from a professional consulting group in Washington DC. The results of this workshop were incorporated into the patient experience feedback summary design for the study clinics and the implementation of trained patient assessment was modified to improve transparency and acceptability. Patients were not directly

involved in the design, nor the recruitment of this sub-study assessing the mental wellness of HCWs. The findings of this study as well as the parent study will be shared with the Zambian Ministry of Health as well as the study facilities.

Ethics

This study was approved as part of the larger PCPH study by the University of Zambia Biomedical Ethics Committee and the University of Alabama at Birmingham Institution Review Board, and the National Health Research Authority in Zambia. We obtained waiver of written informed consent and obtained verbal consent from participants prior to administering the survey.

Results

A total of 713 HCWs from 24 facilities across Lusaka and Chongwe districts in the Lusaka Province were included in the analysis dataset (**Table 1**). Of the 713 responses, 231 (32.4%) reported mild depression (PHQ-9 score 5-9) and 81 (11.4%) reported moderate depression of (PHQ-9 score 10-14). The majority (69.6%) of the PHQ-9 survey responses were collected in September 2020 (**Table 1**). Responses for PHQ-9 questions were largely complete with <1% responses missing.

Table 1: Participant characteristics

Factor	Level	n (%)
N		713
Facility	1	30 (4.2)
	2	30 (4.2)
	3	30 (4.2)
	4	30 (4.2)
	5	30 (4.2)
	6	30 (4.2)
	7	30 (4.2)
	8	30 (4.2)
	9	30 (4.2)
	10	30 (4.2)
	11	30 (4.2)
	12	27 (3.8)

	13	27 (3.8)
	14	30 (4.2)
	15	30 (4.2)
	16	30 (4.2)
	17	30 (4.2)
	18	30 (4.2)
	19	30 (4.2)
	20	30 (4.2)
	21	30 (4.2)
	22	30 (4.2)
	23	29 (4.1)
	24	30 (4.2)
Clinic Population (category)	Small	147 (20.6)
	Medium	269 (37.7)
	Large	297 (41.7)
PHQ-9 Score Category	minimal	379 (53.2)
	mild	231 (32.4)
	moderate	81 (11.4)
	moderately severe	17 (2.4)
	severe	5 (0.7)
Month of Survey	August 2020	205 (28.8)
	September 2020	496 (69.6)
	October 2020	12 (1.7)

Note: PHQ-9 – nine-item patient health questionnaire.

A total of 81 (11.4) respondents had a PHQ-9 score corresponding to moderate depression across all but one facility, 17 (2.4%) respondents had PHQ-9 scores consistent with moderately severe depression across four facilities and five (0.7%) HCWs had PHQ-9 scores consistent with severe depression across five different facilities (**Fig 1, Table 2**).

Table 2: Proportion of the analysis population by PHQ-9 score category with 95% confidence intervals (N=713)

Variable	*n*	*Proportion (%)*	*95% CI*
≥5 PHQ-9 score	334	46.8	(43.1, 50.6)
Mild	231	32.4	(29.0, 36.0)
Moderate	81	11.4	(9.1, 13.9)
Moderate-severe	17	2.4	(1.4, 3.8)
Severe	5	0.7	(0.2, 1.6)

Note: CI – confidence interval; PHQ-9 – nine-item patient health questionnaire.

Though we observed facility-level mental health heterogeneity in proportion of minimal and mild depression scores across clinics, the proportion of scores consistent with moderate depression remain relatively stable across facilities (**Fig 1A).**

Figure 1: A) Stacked bar chart of proportion population by PHQ-9 score category by healthcare facility B) Stacked bar chart of proportion population by PHQ-9 score by facility population size category

Mixed effects adjusted Poisson regression model did not reveal clinic size or month of survey as a significant predictor of PHQ-9 score ≥5 (**Table 3**).

Table 3: Adjusted Poisson regression results (N=713)

Covariate	*level*	*aPR*	*95% CI*	*p-value*
Clinic Population (category)	small	1.12	(0.95, 1.33)	0.170
	medium	1.00 (ref)	ref	ref
	large	1.04	(0.81, 1.33)	0.763
Month of Survey	August	1.00 (ref)	ref	ref
	September	1.14	(0.94, 1.38)	0.193
	October	0.98	(0.54, 1.79)	0.945

Note: adjusted for survey week and facility

We illustrate significant heterogeneity in the marginal probability of experiencing greater than minimal depression across facilities (**Fig 2**). Notably higher marginal probability of HCWs with PHQ-9 score ≥5 was observed in both COVID-19 treatment centers and non-COVID-19 treatment centers, facilities 4 and 16.

Figure 2: Marginal probability of healthcare worker with >minimal depression per PHQ-9 score by clinic.

Note: PHQ-9 – nine-item patient health questionnaire.

Discussion

We found that a large proportion of the HCW population had a PHQ-9 score ≥5 indicating need for some level of mental wellness follow-up 46.8% (95% CI: 43.1, 50.6%). Variation in depression outcomes ranged from 82.7% (95% CI: 68.5, 96.9%) at one of the two large COVID-19 treatment facilities to 28.4% (95% CI: 13.0, 43.9%) at a medium-sized healthcare facility. Differences in clinic characteristics, such as size of catchment population and location could contribute to the variations in depression outcomes among the facilities.

Past studies show that frontline HCW working in clinics, considered to be highly infectious, such as COVID-19 treatment centers, were more prone to developing depression and other mental disorders than their counterparts in other departments [10]. This is in consistent with the results of our study, which shows that HCWs working at COVID-19 treatment facilities had a marginal probability of experiencing mild to moderately severe depression. In addition, results of our study demonstrate that HCWs have experienced symptoms of depression during the onset of the COVID-19 pandemic in Zambia, which is consistent with the findings of similar studies using the PHQ-9 in other parts of the world where a pooled prevalence of mild depression was found to be 36.1% (95% confidence interval [CI], 31.3%-41.0%) [28]. Studies conducted in Zambia among nurses and midwives, and in Ethiopia among different cadres of HCWs shows that mental disorders which include depression are prevalent among HCWs during the COVID-19 pandemic [29]. Similarly, globally studies, indicate, that the risk of HCWs developing mental health disorders during the pandemic exist [3, 28, 29]. The difficult conditions to which HCWs may be exposed including extended working hours, risk of exposure to the disease, increased workload exposure to the disease, concerns about transmitting the infection to their family members, limited resources to care for their patients, may exacerbate or initialize mental wellbeing issues leading to symptoms of depression [30, 31].

The heterogeneity in proportions of HCWs with depression may be driven by facility size, where reduced resources at smaller facilities including, but not limited to, personal protective equipment (PPE), hand hygiene station/station supplies at clinic entrance, and less access to knowledge about the COVID-19 response in Zambia compared to larger facilities in urban Lusaka. While the response to the COVID-19 pandemic was standardized, to a certain extent, by guidance from the

provincial and zonal levels, the culture and leadership unique to each facility might have played a key role in the healthcare worker experience, contributing to PHQ-9 score distribution differences across facilities.

As we continue to recognize the mental health services gap across many populations in resource-limited settings we give evidence here to support prioritization of healthcare workers, especially during public health shocks/emergencies like that presented by COVID-19. Mental wellness challenges among HCWs could lead to poor health outcomes for the HCW workforce and have a sort of "knock-on" effect negatively impacting the quality of care provided to patients [32, 33]. Interventions like Friendship Bench piloted in neighboring Zimbabwe designed to encourage positive coping mechanism among HCWs and build a working environment that provides empathy and compassion towards staff may be an efficient option to provide mental wellness support [34, 35]. Furthermore, system-based interventions should also be encouraged such as change in working culture and reduction in possible system contributors to HCW stress that could lead to depression. Increasing mobile technology availability may further allow for the use of mobile health (mHealth) based mental wellness services leveraging the framework presented by Osei for low- and middle-income countries [36, 37]. Low-cost intervention packages used for patients can be adapted for HCWs and integrated into system-based interventions. They include routine screening for early detection, mental wellness education, problem solving and use of anti-depressants, cognitive behavior therapy which can be delivered successfully by trained lay HCWs [38, 39].

Limitations

This study had some potential limitations. Firstly, we did not collect participants demographics such as age, sex, marital status, and sex. As such we were not able to adjust for these co- founders. Accounting for these would help make associations in outcomes of depression. Secondly, we employed convenience sampling in selecting participants, this sampling approach may limit representativeness of study the results to the wider population of HCWs. Finally, without pre-COVID 19 estimates of depression among healthcare workers in Lusaka, we are not able to show association between mild-severe depression with the pandemic however, we show that during the pandemic that depression was high and attention to this population is justified to ensure a healthy

HCW workforce. Additionally, though potentially highest than a non-pandemic baseline, these results may be useful as subsequent measures of depression and mental wellness are collected among HCWs.

Conclusions

Depression is a common public health problem; our study demonstrates that HCWs in Zambia may suffer from a high prevalence of depressive symptoms. Routine mental health wellness is important to better understand the role that the COVID-19 pandemic may have had on depression among HCWS in Zambia. Furthermore, support for HCW mental wellness can serve to accelerate destigmatizing mental health issues and improve the quality of care provided across healthcare centers in Zambia.

Competing interests

Authors do not have competing interests to report.

Authors' contributions

SS: Data Collection, Data Framing, Manuscript Writing

JM: Data Collection, Data Curation, Data Analysis

MM: Data Collection, Data Curation

LJ: Data Framing

CB: Data Framing

KS: Conceptualization

IS: Conceptualization

CBM: Conceptualization

AM: Analysis Review, Manuscript Review/Editing

EHG: Conceptualization

AS: Conceptualization, Manuscript Review/Editing

LKB: Conceptualization, Data Analysis, Data Framing, Manuscript Writing

JMP: Data Analysis Lead, Data Framing, Manuscript Writing

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[not aware of anything needed here]

Acknowledgements

We would like to thank the Zambian Ministry of Health for their leadership to ensure those in care continue to receive life-saving HIV treatment. We would also like to thank the healthcare workers for their participation in the PHQ-9 assessment as well as their faithful delivery of care to patients in the face of the many challenges presented by the COVID-19 pandemic. To the clients seen at our study facilities we would like to extend sincere thanks for your cooperation and patience.

Funding

Research reported in this publication was supported by the Bill & Melinda Gates Foundation grant number OPP1166485, the National Institute Of Mental Health of the National Institutes of Health under award number F31MH109378 (L.K.B.), and the National Institute of Allergy and Infectious Diseases of the National Institutes of Health under award number K24 AI134413 (E.G.).

Disclaimer

None

List of abbreviations [Optional]

ART: antiretroviral therapy

CI- Confidence Interval

COVID-19: Coronavirus Disease 2019

HCW: Health Care Worker

PCPH: Person- Centered Public Health for HIV Treatment in Zambia

PHQ-9: Patient Health Questionnaire 9

Data Sharing

Data used for this analysis is available through Dryad data repository (doi:10.25338/B8S646)

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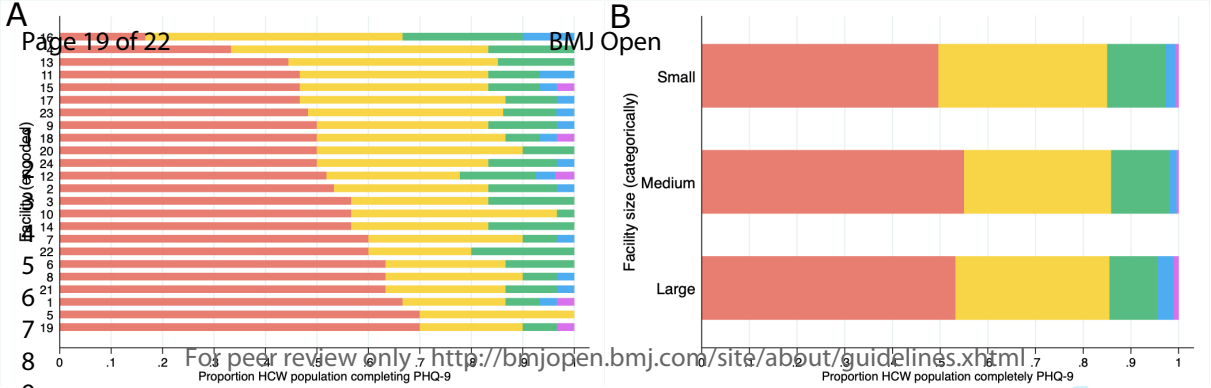
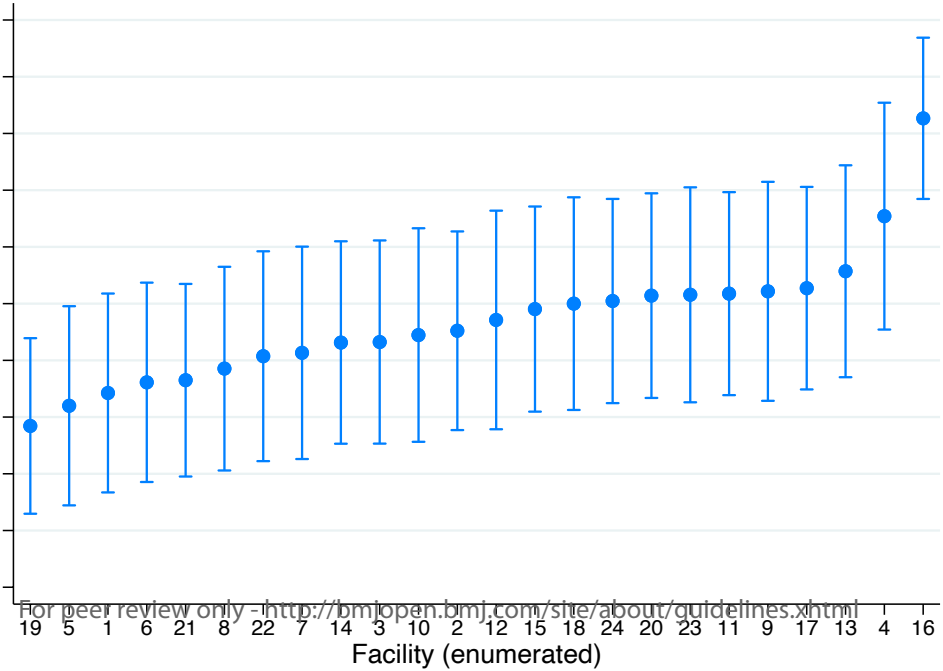
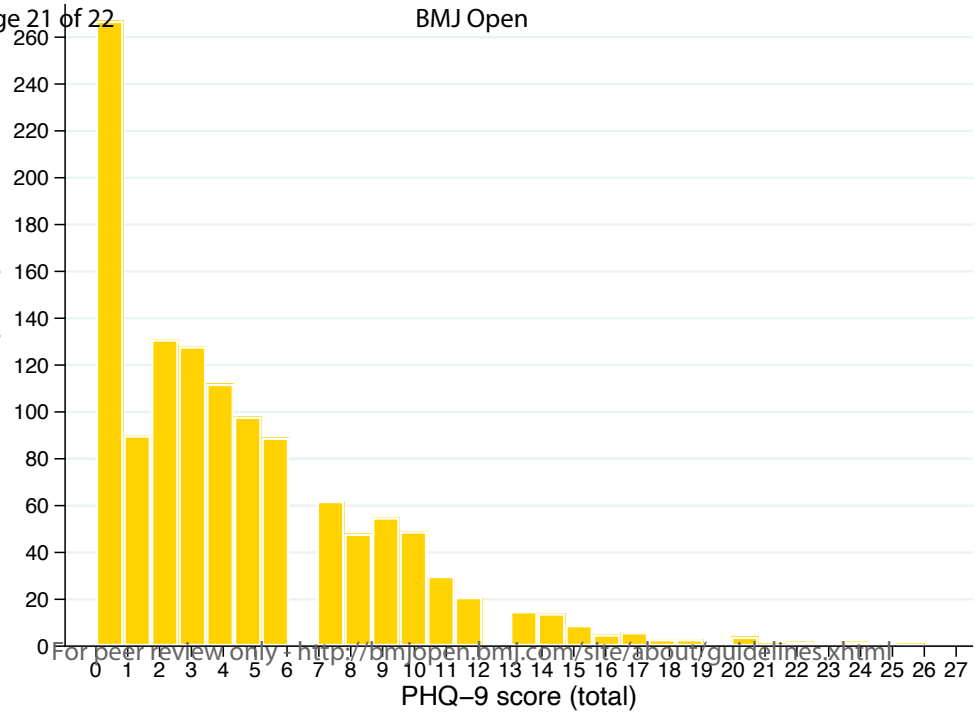
Supplement:

Figure S1: Histogram of total PHQ-9 scores among study participants







STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4, 5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5, 6
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5, 6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5, 6
Bias	9	Describe any efforts to address potential sources of bias	5, 6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5, 6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, explain how loss to follow-up was addressed	NA
		(*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7, 8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7, 8
		(b) Indicate number of participants with missing data for each variable of interest	7, 8
		(c) Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	Report numbers of outcome events or summary measures over time	7, 8

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	7, 8 7, 8 NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11, 12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9, 10
Generalisability	21	Discuss the generalisability (external validity) of the study results	9, 10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13, 14

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

BMJ Open

A cross-sectional study to assess depression among health care workers in Lusaka, Zambia during the COVID-19 pandemic

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-069257.R1
Article Type:	Original research
Date Submitted by the Author:	29-Dec-2022
Complete List of Authors:	Simbeza, Sandra; Center for Infectious Disease Research in Zambia Mutale, Jacob; Center for Infectious Disease Research in Zambia, Implementation Science Unit Mulabe, Musunge; Center for Infectious Disease Research in Zambia Jere, Lazarus; Center for Infectious Disease Research in Zambia Bukankala, Chama; Center for Infectious Disease Research in Zambia Sikombe, Kombatende; Center for Infectious Disease Research in Zambia, Implementation Science Unit, Research department Sikazwe, Izukanji; Center for Infectious Disease Research in Zambia, Chief Executive Officer Bolton-Moore, Carolyn; Center for Infectious Disease Research in Zambia; The University of Alabama at Birmingham School of Medicine, Infectious Disease Mody, Aaloke; Washington University in St Louis, Infectious Diseases Geng, Elvin; Washington University in St Louis School of Medicine Sharma, Anjali; Center for Infectious Disease Research in Zambia Beres, Laura K ; Johns Hopkins University Bloomberg School of Public Health, Department of International Health Pry, Jake; Center for Infectious Disease Research in Zambia, Implementation Science Unit; University of California Davis School of Medicine, Public Health Sciences
Primary Subject Heading:	Mental health
Secondary Subject Heading:	HIV/AIDS, Health services research, Haematology (incl blood transfusion), Epidemiology, Global health
Keywords:	COVID-19, EPIDEMIOLOGY, HIV & AIDS < INFECTIOUS DISEASES, MENTAL HEALTH

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A cross-sectional study to assess depression among health care workers in Lusaka, Zambia during the COVID-19 pandemic.

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Keywords: Health Care Workers, Depression, COVID-19, PHQ-9

Abstract

Objectives: We sought to assess depression among health care workers (HCWs) in the context of COVID-19 in Lusaka Province, Zambia.

Design: This cross-sectional study is nested within a larger study, Person Centered Public Health for HIV Treatment in Zambia (PCPH), a cluster-randomized trial to assess HIV care and outcomes.

Setting: The research was conducted in 24 government-run health facilities during 11 August - 15 October 2020 during the second wave of the COVID-19 epidemic in Lusaka, Zambia.

Participants: We used convenience sampling to recruit HCW participants who were previously enrolled in the PCPH study, had more than 6 months experience working at the facility and were voluntarily willing to participate.

Primary outcome measures: We implemented the well-validated Patient Health Questionnaire (PHQ-9) to assess HCW depression. We used mixed-effects, adjusted Poisson regression to estimate the marginal probability of HCW experiencing depression that may warrant intervention (PHQ-9 score ≥5) by health care facility.

Results: We collected PHQ-9 survey responses from 713 professional and lay HCWs. Overall, 334 (46.8%, 95% CI: 43.1, .50.6%) HCWs recorded a PHQ-9 score ≥5, indicating the need for further assessment and potential intervention for depression We identified significant heterogeneity across facilities and observed a greater proportion of HCWs with symptoms of depression in facilities providing COVID-19 testing and treatment services.

Conclusions: Depression may be a concern for a large proportion of HCW in Zambia. Further work to understand the magnitude and etiologies of depression amongst HCW in the public sector is needed to design effective preventative and treatment interventions to meet the need for mental health support and to minimize poor health outcomes.

BMJ Open Questions:

Strengths and Limitations of this study

- These data represent important insight regarding the state of mental wellness among a large sample of health care workers during a public health crisis in a resource limited setting.
- Mental wellness, like depression, is not documented well in resource limited settings and we measure here mental wellness in a high-risk group of health care workers during the COVID-19 pandemic.
- We include a large number (N=24) of facilities to appreciate the heterogeneity in symptoms of depression among mental health in the sampled facilities in Lusaka Province of Zambia.
- An important limitation is lack of data on demographics of health care worker respondents due to concern about stigma around mental wellness and potential to identify individuals given inclusion of clinics with small staff.
- Without pre-COVID 19 estimates of depression among health care workers in Lusaka, we are not able to show association between mild-severe depression with the pandemic; however, we show that during the pandemic that depression was high and attention to this population is justified to ensure a healthy HCW workforce.

Introduction

Coronavirus disease 2019 (COVID-19) has caused substantial global health hardship and health care workers (HCWs) position on the frontlines of the public health response places them at great risk for negative effects on health and wellbeing[1,[1]. In addition to excess occupational hazard of contracting COVID-19, their experience as care givers increases their risk of developing mental health disorders such as anxiety, depression, trauma, insomnia, and stress, which may lead to poor physical and psychological wellbeing [2]. A healthy workforce is critical to effectively managing and mitigating COVID-19, as well as providing continuity of high-quality care for other chronic and acute health conditions [3, 4]. Even prior to COVID-19, countries in sub-Saharan Africa faced limited medical infrastructure, supplies, and an over-burdened workforce, which challenged HCW wellbeing and the provision of quality health care [5, 6]. These challenges, along with pandemic-sensitive barriers such as limited access to personal protective equipment (PPE) further exacerbated HCW stress and vulnerability. While HCWs in resource limited settings have demonstrated resilience, poor mental health is likely to compromise their ability to make decisions, as well as impact patient interactions [7]. Mental health services, like other health resources, are limited, with few trained mental health providers[8]. Understanding mental health and wellbeing among HCWs can catalyze interventions to provide treatment and improve the health care facility environment for the HCWs and patients [8].

Several studies have been conducted to assess mental wellness impact of the pandemic amongst HCWs however, the majority of these studies focus on the continent of Asia and very little data is available for HCWs in Africa [9-11]. Limited data from Kenya and Ethiopia provides evidence that the prevalence of mental disorders such as depression, insomnia and stress were higher among those HCWs caring for patients with COVID-19, or in areas of higher infection prevalence compared to those working with non-COVID-19 patients or less [2, 12-16]. The most prevalent reported mental health conditions among health care workers are depression, insomnia, and anxiety [17]. Characterization of the state of mental wellness during the COVID-19 pandemic in Sub-Saharan African countries among HCWs, specifically in Zambia remains incomplete [12, 18].

As part of a larger patient-centered care study, we collected facility-level measures to understand the context of care at 24 study sites. As a part of establishing care context we assessed mental

health, specifically depression, using the nine item Patient Health Questionnaire (PHQ-9) in the context of COVID-19 among HCWs in Lusaka Province, Zambia from 11 August 2020 to 15 October 2020 [19].

Methods

Setting

This cross-sectional study of HCW depression is nested within a larger study, Person Centered Public Health for HIV Treatment in Zambia (PCPH), a cluster-randomized trial to assess HIV care and outcomes running from August 2018 to November 2021 across 24 government-funded health facilities in Lusaka Province (Pan African Clinical Trial Registry number: PACTR202101847907585). All PHQ-9 responses were collected between 11 August 2020 and 15 October 2020 among participating facilities that offered HIV care services and varied in size and location. Facilities were assigned codes to protect the identity of the HCW participants.

Study Population

We developed a cohort of HCWs that primarily provide HIV care at one of the 24 health facilities in the PCPH study. This was done by compiling all HCW's contact details from the HCWs who had, at the time of the introduction of the depression study, participated in the HCW survey component of the original PCPH study. The PCPH sample was comprised of both professional HCWs including nurses, pharmacists, midwives, medical doctors, radiographers, and lay HCWS including treatment supporters and general workers. To augment participation in the PHQ-9 data collection, we expanded the PHQ-9 sample to include any HCW willing to participate and had ≥6 months working experience at the study facility. We informed the facility in-charge of the PHQ-9 study opportunity who communicated it to staff members.

Measurements

Trained study research assistants visited health care facilities and discussed the study opportunity in-person with available staff members. Those who expressed interest were screened for eligibility, offered the opportunity to verbally consent and with immediate participation. As a part of the PCPH adaptation to the COVID-19 pandemic, we implemented the nine-question Patient Health Questionnaire (PHQ-9) to screen for presence and severity of depression. The PHQ-9 has been

previously used in Zambia to screen for likelihood of depression [20], and has been validated in Tanzania and South Africa which are similar settings as Zambia [20, 21]. The PHQ-9 instrument was translated from English into Nyanja and Bemba, the most commonly spoken Zambian languages in Lusaka Province, where the survey was conducted [22]. Depending on the participant preference, the standard PHQ-9 survey was self-administered on paper or surveyor-administered by trained study research assistants in the participant's preferred language. Potentially identifying information such as age, sex, and HCW cadre were not collected from respondents to protect privacy. Facility populations were categorized as small (<40,000 clients/year), medium (40,000-99,999 visits/year), and large (≥100,000 visits/year) as recorded in 2019.

Analysis

We followed the standard, 27-point scoring system for the PHQ-9 to identify participants with scores consistent with minimal (0-4), mild (5-9), moderate (10-14), moderately severe (15-19), and severe depression (20-27) [19]. Our main outcome was mild depression or greater (PHQ-9 score >=5) as this level of depression warrants additional clinical follow-up [19]. We developed frequency tables and used a bar graphs to illustrate the distribution of PHQ-9 scores by health care facility. We developed scatter plots of adjusted marginal probability with 95% confidence intervals to illustrate the probability that a HCW will have a PHQ-9 score ≥5 by health care facility. We used mixed effects Poisson regression to estimate prevalence ratios for those with mild depression allowing random effects at the facility level and measured fixed effects for month of survey and clinic size category. Facilities were categorized by client population estimates as: small (<40,000 clients), medium (40,000-100,000 clients), and large (>100,000 clients).

Patient and Public Involvement

The parent study, focused primarily on improving the patient experience at routine clinic visits through HCW training, mentorship, and audit and feedback The research approach and content is based on participatory research with HCWs, human-centered design workshops, and stakeholder collaborations [23-29]. This research guided us to include measures of HCW satisfaction and wellbeing. In addition to a HCW experience measure throughout PCPH, the advent of COVID-19 led us to include an assessment of HCW depression. Patients were not directly involved in the design, nor the recruitment of this sub-study assessing the depression levels of HCWs. The

findings of this study as well as the parent study will be shared with the Zambian Ministry of Health as well as the study facilities.

Ethics

This study was approved as part of the larger PCPH study by the University of Zambia Biomedical Ethics Committee and the University of Alabama at Birmingham Institution Review Board, and the National Health Research Authority in Zambia. We obtained waiver of written informed consent and obtained verbal consent from participants prior to administering the survey.

Results

A total of 713 HCWs from 24 facilities across Lusaka and Chongwe districts in the Lusaka Province were included in the analysis dataset (**Table 1**). The majority (69.6%) of the PHQ-9 survey responses were collected in September 2020 (**Table 1**). The largest proportion of the responses were collected at facilities serving a large client population (41.7%) followed closely by facilities serving s medium-sized client population (37.7%) (**Table 1**). Responses for PHQ-9 questions were largely complete with <1% responses missing.

Table 1: Participant characteristics

Factor	Level	n (%)
N		713
Facility	1	30 (4.2)
	2	30 (4.2)
	3	30 (4.2)
	4	30 (4.2)
	5	30 (4.2)
	6	30 (4.2)
	7	30 (4.2)
	8	30 (4.2)
	9	30 (4.2)
	10	30 (4.2)
	11	30 (4.2)
	12	27 (3.8)
	13	27 (3.8)

	14	30 (4.2)
	15	30 (4.2)
	16	30 (4.2)
	17	30 (4.2)
	18	30 (4.2)
	19	30 (4.2)
	20	30 (4.2)
	21	30 (4.2)
	22	30 (4.2)
	23	29 (4.1)
	24	30 (4.2)
Clinic Population (category)	Small	147 (20.6)
	Medium	269 (37.7)
	Large	297 (41.7)
Month of Survey	August 2020	205 (28.8)
	September 2020	496 (69.6)
	October 2020	12 (1.7)

Note:

Of the 713 responses, 231 (32.4%, 95%CI: 29.0-36.0) reported mild depression (PHQ-9 score 5-9), 81 (11.4% 95%CI: 9.1-13.9) reported moderate depression (PHQ-9 score 10-14). A total of 81 (11.4) respondents had a PHQ-9 score corresponding to moderate depression across all but one facility, 17 (2.4%, 95%CI: 1.4-3.8) respondents had PHQ-9 scores consistent with moderately severe depression across four facilities, and five (0.7%, 95%CI: 0.2-1.6) HCWs had PHQ-9 scores consistent with severe depression across five different facilities (**Fig 1, Fig S1, Table 2**).

Table 2: Proportion of the analysis population by PHQ-9 score category with 95% confidence intervals (N=713)

Variable	*n*	*Proportion (%)*	*95% CI*
≥5 PHQ-9 score	334	46.8	(43.1, 50.6)
Mild	231	32.4	(29.0, 36.0)
Moderate	81	11.4	(9.1, 13.9)
Moderate-severe	17	2.4	(1.4, 3.8)
Severe	5	0.7	(0.2, 1.6)

Note: CI – confidence interval; PHQ-9 – nine-item patient health questionnaire.

Though we observed facility-level mental health heterogeneity in the proportion of minimal and mild depression scores across clinics, the proportion of scores consistent with moderate depression remain relatively stable across facilities (**Fig 1A).**

Figure 1: A) Stacked bar chart of proportion population by PHQ-9 score category by health care facility B) Stacked bar chart of proportion population by PHQ-9 score by facility population size category

Mixed effects adjusted Poisson regression model did not reveal clinic size or month of survey as a significant predictor of PHQ-9 score ≥5 (**Table 3**).

Table 3: Adjusted Poisson regression results (N=713)

Covariate	*level*	*aPR*	*95% CI*	*p-value*
Clinic Population (category)	small	1.12	(0.95, 1.33)	0.170
	medium	1.00 (ref)	ref	ref
	large	1.04	(0.81, 1.33)	0.763
Month of Survey	August	1.00 (ref)	ref	ref
	September	1.14	(0.94, 1.38)	0.193
	October	0.98	(0.54, 1.79)	0.945

Note: adjusted for survey week and facility

We illustrate significant heterogeneity in the marginal probability of experiencing greater than minimal depression across facilities (**Fig 2**). Notably, the highest marginal probability of HCWs with PHQ-9 score ≥5 was observed in a facility serving as a COVID-19 treatment center.

Figure 2: Marginal probability of health care worker with >minimal depression per PHQ-9 score by clinic.

Note: PHQ-9 – nine-item patient health questionnaire.

Discussion

We found that a large proportion of the HCW population had a PHQ-9 score ≥5 indicating a need for follow-up to assess and improve mental wellbeing 46.8% (95% CI: 43.1, 50.6%). Variation in

depression outcomes ranged from 82.7% (95% CI: 68.5, 96.9%) at one of the two large COVID-19 treatment facilities to 28.4% (95% CI: 13.0, 43.9%) at a medium-sized health care facility.

Our study shows that HCWs working at COVID-19 treatment facilities had a higher marginal probability of experiencing mild to moderately severe depression. This is consistent with past studies showing that frontline HCW working in clinics managing diseases considered to be highly infectious, such as COVID-19 treatment centers, were more prone to developing depression and other mental disorders than their counterparts in other departments [12]. In addition, results of our study demonstrate that HCWs have experienced symptoms of depression during the onset of the COVID-19 pandemic in Zambia, which is consistent with the findings of similar studies using the PHQ-9 in other parts of the world where a pooled prevalence of mild depression was found to be 36.1% (95% confidence interval [CI], 31.3%-41.0%) [30]. Studies conducted in Zambia among nurses and midwives, and in Ethiopia among different cadres of HCWs show that mental disorders which include depression are prevalent among HCWs during the COVID-19 pandemic [31]. Similarly, globally studies indicate that there is a risk of HCWs developing mental health disorders during the pandemic [4, 30, 31]. The difficult conditions to which HCWs may be exposed including extended working hours, risk of exposure to the disease, increased workload, concerns about transmitting the infection to their family members, reduced social connectedness, and limited resources to care for their patients may amplify poor mental wellbeing [1, 32-34].

Further research is needed to understand heterogeneity in proportions of HCWs with depression. It may be associated variation in HCW access to resources such as, personal protective equipment (PPE), hand hygiene station/station supplies at clinic entrance, and knowledge about the COVID-19 response in Zambia. While the response to the COVID-19 pandemic was standardized, to a certain extent, by guidance from the provincial and zonal levels, the culture and leadership unique to each facility might have played a key role in the health care worker experience, contributing to PHQ-9 score distribution differences across facilities.

As we continue to recognize the mental health services gap across many populations in resource-limited settings we give evidence here to support prioritization of health care workers, especially during public health shocks/emergencies like that presented by COVID-19.Presenceof depression

among HCWs could lead to poor health outcomes for the HCW workforce and have a sort of "knock-on" effect negatively impacting the quality of care provided to patients [35, 36]. Interventions like Friendship Bench piloted in neighboring Zimbabwe designed to encourage positive coping mechanism among HCWs and build a working environment that provides empathy and compassion towards staff may be an efficient option to provide mental wellness support [37, 38]. Furthermore, system-based interventions should also be encouraged such as change in working culture and reduction in possible system contributors to HCW stress that could lead to depression. Increasing mobile technology availability may further allow for the use of mobile health (mHealth) based mental wellness services leveraging the framework presented by Osei for low- and middle-income countries [39, 40]. Low-cost intervention packages used for patients can be adapted for HCWs and integrated into system-based interventions. They include routine screening for early detection, mental wellness education, problem solving and use of anti-depressants, cognitive behavior therapy which can be delivered successfully by trained lay HCWs [41, 42].

Limitations

This study had some potential limitations. Firstly, we did not collect participants demographics such as age, sex, marital status, and sex. As such we were not able to adjust for these co- founders. Accounting for these would help make associations in outcomes of depression. Secondly, we employed convenience sampling in selecting participants, this sampling approach may limit representativeness of study the results to the wider population of HCWs. Finally, without pre-COVID 19 estimates of depression among health care workers in Lusaka, we are not able to show association between mild-severe depression with the pandemic however, we show that during the pandemic that depression was high and attention to this population is justified to ensure a healthy HCW workforce. Additionally, though potentially highest than a non-pandemic baseline, these results may be useful as subsequent measures of depression and mental wellness are collected among HCWs.

Conclusions

Depression is a common public health problem; our study demonstrates that HCWs in Zambia may suffer from a high prevalence of depressive symptoms that will require additional clinical

follow up. Routine mental health wellness is important to better understand the role that the COVID-19 pandemic may have had on depression among HCWS in Zambia. Furthermore, support for HCW mental wellness can serve to accelerate destigmatizing mental health issues and improve the quality of care provided across health care centers in Zambia.

Contributorship

SS: data collection, data Framing, and manuscript writing, JM, KS, and MM: data collection and data curation, LJ and CB: data framing, IS, CBM and EHG: conceptualization, AM: manuscript review/editing, AS: conceptualization and manuscript review/editing LKB: conceptualization, data analysis, data framing, and manuscript writing, JMP: data analysis lead, data framing, and manuscript writing. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Funding

Research reported in this publication was supported by the Bill & Melinda Gates Foundation grant number OPP1166485, the National Institute of Mental Health of the National Institutes of Health under award number F31MH109378 (L.K.B.), and the National Institute of Allergy and Infectious Diseases of the National Institutes of Health under award number K24 AI134413 (E.G.).

Competing of Interests

None

Ethical Approval

This study was approved as part of the larger PCPH study by the University of Zambia Biomedical Ethics Committee and the University of Alabama at Birmingham Institution Review Board, and the National Health Research Authority in Zambia. We obtained waiver of written informed consent and obtained verbal consent from participants prior to administering the survey.

Data Sharing

Data used for all analyses will be made available for public use through Dryad data repository: Pry, Jake et al. (2022), PHQ-9_PCPH-19aug2022, https://doi.org/10.25338/B8S646.

Acknowledgements

We would like to thank the Zambian Ministry of Health for their leadership to ensure those in care continue to receive life-saving HIV treatment. We would also like to thank the health care

workers for their participation in the PHQ-9 assessment as well as their faithful delivery of care to patients in the face of the many challenges presented by the COVID-19 pandemic. To the clients seen at our study facilities we would like to extend sincere thanks for your cooperation and patience.

List of abbreviations [Optional]

ART: antiretroviral therapy

CI- Confidence Interval

COVID-19: Coronavirus Disease 2019

HCW: Health Care Worker

PCPH: Person- Centered Public Health for HIV Treatment in Zambia

PHQ-9: Patient Health Questionnaire 9

Data Sharing

Data used for this analysis is available through Dryad data repository (doi:10.25338/B8S646)

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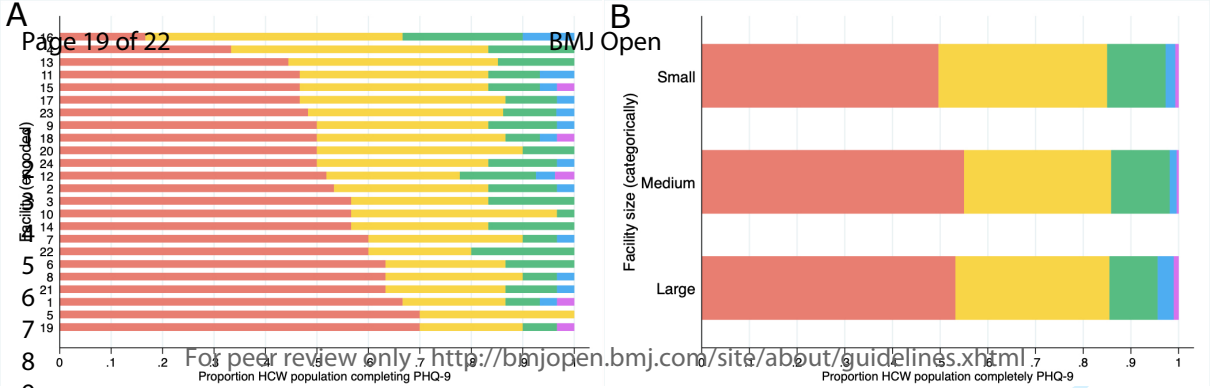
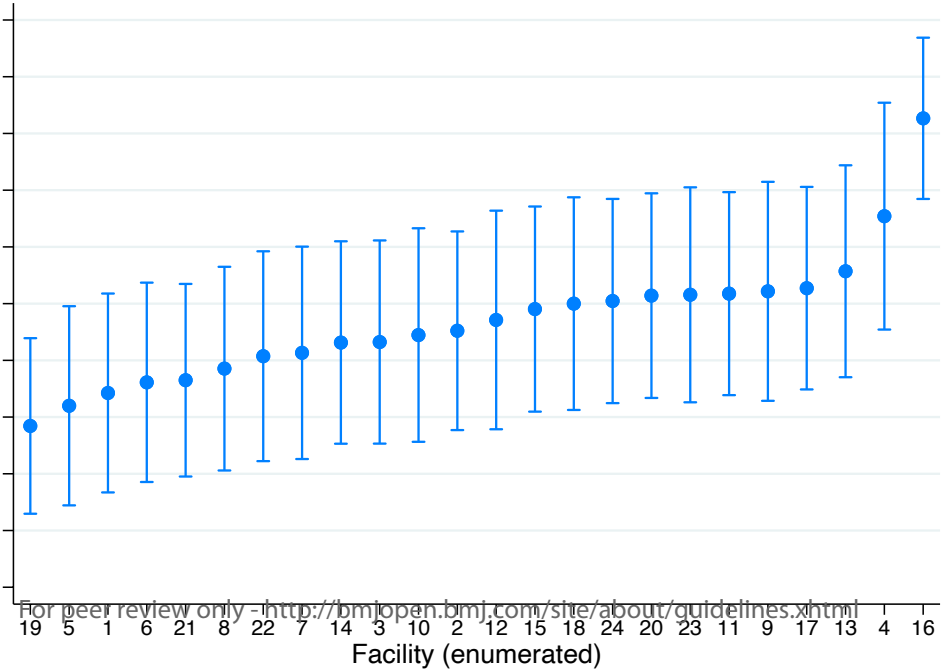
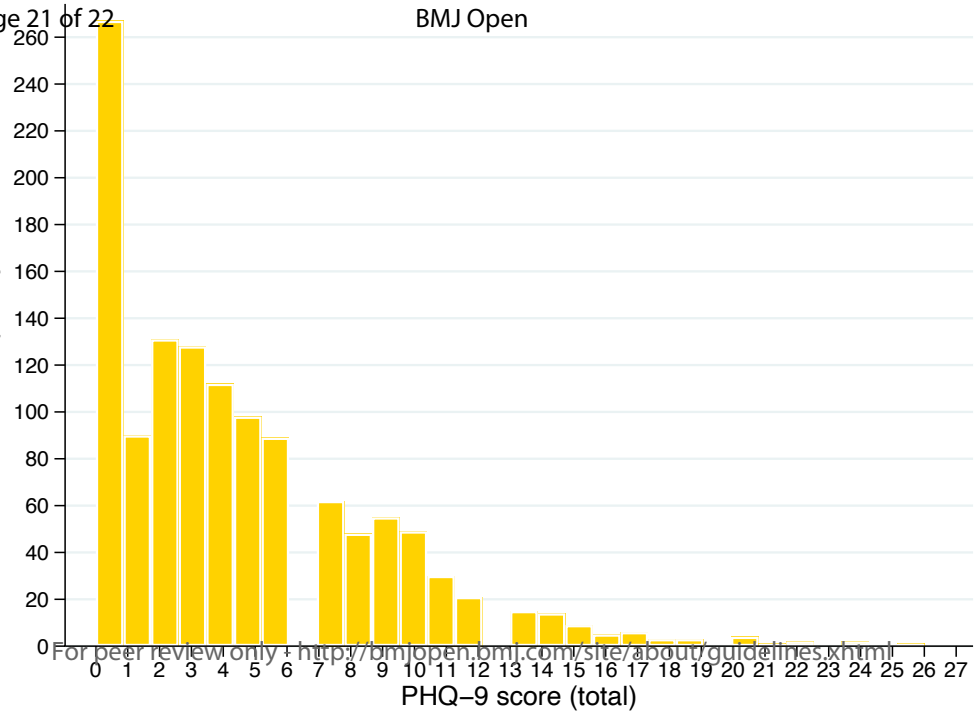
Supplement:

Figure S1: Histogram of total PHQ-9 scores among study participants







STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4, 5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5, 6
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5, 6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5, 6
Bias	9	Describe any efforts to address potential sources of bias	5, 6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5, 6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, explain how loss to follow-up was addressed	NA
		(*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7, 8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7, 8
		(b) Indicate number of participants with missing data for each variable of interest	7, 8
		(c) Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	Report numbers of outcome events or summary measures over time	7, 8

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	7, 8 7, 8 NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11, 12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9, 10
Generalisability	21	Discuss the generalisability (external validity) of the study results	9, 10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13, 14

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

BMJ Open

A cross-sectional study to assess depression among health care workers in Lusaka, Zambia during the COVID-19 pandemic

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-069257.R2
Article Type:	Original research
Date Submitted by the Author:	08-Mar-2023
Complete List of Authors:	Simbeza, Sandra; Center for Infectious Disease Research in Zambia Mutale, Jacob; Center for Infectious Disease Research in Zambia, Implementation Science Unit Mulabe, Musunge; Center for Infectious Disease Research in Zambia Jere, Lazarus; Center for Infectious Disease Research in Zambia Bukankala, Chama; Center for Infectious Disease Research in Zambia Sikombe, Kombatende; Center for Infectious Disease Research in Zambia, Implementation Science Unit, Research department Sikazwe, Izukanji; Center for Infectious Disease Research in Zambia, Chief Executive Officer Bolton-Moore, Carolyn; Center for Infectious Disease Research in Zambia; The University of Alabama at Birmingham School of Medicine, Infectious Disease Mody, Aaloke; Washington University in St Louis, Infectious Diseases Geng, Elvin; Washington University in St Louis School of Medicine Sharma, Anjali; Center for Infectious Disease Research in Zambia Beres, Laura K ; Johns Hopkins University Bloomberg School of Public Health, Department of International Health Pry, Jake; Center for Infectious Disease Research in Zambia, Implementation Science Unit; University of California Davis School of Medicine, Public Health Sciences
Primary Subject Heading:	Mental health
Secondary Subject Heading:	HIV/AIDS, Health services research, Epidemiology, Global health
Keywords:	COVID-19, EPIDEMIOLOGY, HIV & AIDS < INFECTIOUS DISEASES, MENTAL HEALTH

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A cross-sectional study to assess depression among health care workers in Lusaka, Zambia during the COVID-19 pandemic.

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Keywords: Health Care Workers, Depression, COVID-19, PHQ-9

Abstract

Objectives: We sought to assess depression among health care workers (HCWs) in the context of COVID-19 in Lusaka Province, Zambia.

Design: This cross-sectional study is nested within a larger study, Person Centered Public Health for HIV Treatment in Zambia (PCPH), a cluster-randomized trial to assess HIV care and outcomes.

Setting: The research was conducted in 24 government-run health facilities during 11 August - 15 October 2020 during the first wave of the COVID-19 epidemic in Lusaka, Zambia.

Participants: We used convenience sampling to recruit HCW participants who were previously enrolled in the PCPH study, had more than 6 months experience working at the facility and were voluntarily willing to participate.

Primary outcome measures: We implemented the well-validated Patient Health Questionnaire (PHQ-9) to assess HCW depression. We used mixed-effects, adjusted Poisson regression to estimate the marginal probability of HCW experiencing depression that may warrant intervention (PHQ-9 score ≥5) by health care facility.

Results: We collected PHQ-9 survey responses from 713 professional and lay HCWs. Overall, 334 (46.8%, 95% CI: 43.1, .50.6%) HCWs recorded a PHQ-9 score ≥5, indicating the need for further assessment and potential intervention for depression We identified significant heterogeneity across facilities and observed a greater proportion of HCWs with symptoms of depression in facilities providing COVID-19 testing and treatment services.

Conclusions: Depression may be a concern for a large proportion of HCW in Zambia. Further work to understand the magnitude and etiologies of depression amongst HCW in the public sector is needed to design effective preventative and treatment interventions to meet the need for mental health support and to minimize poor health outcomes.

BMJ Open Questions:

Strengths and Limitations of this study

- These data represent important insights regarding the state of mental wellness among a large sample of health care workers during a public health crisis in a resource limited setting, where mental wellness, such as depression, is often not measured nor documented.
- We include a large number (N=24) of facilities to appreciate the heterogeneity in symptoms of depression among mental health in the sampled facilities in Lusaka Province of Zambia.
- An important limitation is lack of data on demographics of health care worker respondents due to concern about stigma around mental wellness and potential to identify individuals given inclusion of clinics with small staff.
- Without pre-COVID 19 estimates of depression among health care workers in Lusaka, we are not able to show association between mild-severe depression with the pandemic; however, we show that during the pandemic that depression was high and attention to this population is justified to ensure a healthy HCW workforce.
- We employed convenience sampling in selecting participants which may limit representativeness of study results to the wider population of HCWs.

Introduction

Coronavirus disease 2019 (COVID-19) has caused substantial global health hardship and health care workers (HCWs) position on the frontlines of the public health response places them at great risk for negative effects on health and wellbeing[1,[1]. In addition to excess occupational hazard of contracting COVID-19, their experience as care givers increases their risk of developing mental health disorders such as anxiety, depression, trauma, insomnia, and stress, which may lead to poor physical and psychological wellbeing [2]. A healthy workforce is critical to effectively managing and mitigating COVID-19, as well as providing continuity of high-quality care for other chronic and acute health conditions [3, 4]. Even prior to COVID-19, countries in sub-Saharan Africa faced limited medical infrastructure, supplies, and an over-burdened workforce, which challenged HCW wellbeing and the provision of quality health care [5, 6]. These challenges, along with pandemic-sensitive barriers such as limited access to personal protective equipment (PPE) further exacerbated HCW stress and vulnerability. While HCWs in resource limited settings have demonstrated resilience, poor mental health is likely to compromise their ability to make decisions, as well as impact patient interactions [7]. Mental health services, like other health resources, are limited, with few trained mental health providers[8]. Understanding mental health and wellbeing among HCWs can catalyze interventions to provide treatment and improve the health care facility environment for the HCWs and patients [8].

Several studies have been conducted to assess mental wellness impact of the pandemic amongst HCWs however, the majority of these studies focus on the continent of Asia and very little data is available for HCWs in Africa [9-11]. Limited data from Kenya and Ethiopia provides evidence that the prevalence of mental disorders such as depression, insomnia and stress were higher among those HCWs caring for patients with COVID-19, or in areas of higher infection prevalence compared to those working with non-COVID-19 patients or less [2, 12-16]. The most prevalent reported mental health conditions among health care workers are depression, insomnia, and anxiety [17]. Characterization of the state of mental wellness during the COVID-19 pandemic in Sub-Saharan African countries among HCWs, specifically in Zambia remains incomplete [12, 18].

As part of a larger patient-centered care study, we collected facility-level measures to understand the context of care at 24 study sites. As a part of establishing care context we assessed mental

health, specifically depression, using the nine item Patient Health Questionnaire (PHQ-9) in the context of COVID-19 among HCWs in Lusaka Province, Zambia from 11 August 2020 to 15 October 2020 [19].

Methods

Setting

This cross-sectional study of HCW depression is nested within a larger study, Person Centered Public Health for HIV Treatment in Zambia (PCPH), a cluster-randomized trial to assess HIV care and outcomes running from August 2018 to November 2021 across 24 government-funded health facilities in Lusaka Province (Pan African Clinical Trial Registry number: PACTR202101847907585). All PHQ-9 responses were collected between 11 August 2020 and 15 October 2020 among participating facilities that offered HIV care services and varied in size and location. Facilities were assigned codes to protect the identity of the HCW participants.

Study Population

We developed a cohort of HCWs that primarily provide HIV care at one of the 24 health facilities in the PCPH study. This was done by compiling all HCW's contact details from the HCWs who had, at the time of the introduction of the depression study, participated in the HCW survey component of the original PCPH study. The PCPH sample was comprised of both professional HCWs including nurses, pharmacists, midwives, medical doctors, radiographers, and lay HCWS including treatment supporters and general workers. To augment participation in the PHQ-9 data collection, we expanded the PHQ-9 sample to include any HCW willing to participate and had ≥6 months working experience at the study facility. We informed the facility in-charge of the PHQ-9 study opportunity who communicated it to staff members.

Measurements

Trained study research assistants visited health care facilities and discussed the study opportunity in-person with available staff members. Those who expressed interest were screened for eligibility, offered the opportunity to verbally consent and with immediate participation. As a part of the PCPH adaptation to the COVID-19 pandemic, we implemented the nine-question Patient Health Questionnaire (PHQ-9) to screen for presence and severity of depression. The PHQ-9 has been

previously used in Zambia to screen for likelihood of depression [20], and has been validated in Tanzania and South Africa which are similar settings as Zambia [20, 21]. The PHQ-9 instrument was translated from English into Nyanja and Bemba, the most commonly spoken Zambian languages in Lusaka Province, where the survey was conducted [22]. Depending on the participant preference, the standard PHQ-9 survey was self-administered on paper or surveyor-administered by trained study research assistants in the participant's preferred language. Potentially identifying information such as age, sex, and HCW cadre were not collected from respondents to protect privacy. Facility populations were categorized as small (<40,000 clients/year), medium (40,000-99,999 visits/year), and large (≥100,000 visits/year) as recorded in 2019.

Analysis

We followed the standard, 27-point scoring system for the PHQ-9 to identify participants with scores consistent with minimal (0-4), mild (5-9), moderate (10-14), moderately severe (15-19), and severe depression (20-27) [19]. Our main outcome was mild depression or greater (PHQ-9 score >=5) as this level of depression warrants additional clinical follow-up [19]. We developed frequency tables and used a bar graphs to illustrate the distribution of PHQ-9 scores by health care facility. We developed scatter plots of adjusted marginal probability with 95% confidence intervals to illustrate the probability that a HCW will have a PHQ-9 score ≥5 by health care facility. We used mixed effects Poisson regression to estimate prevalence ratios for those with mild depression allowing random effects at the facility level and measured fixed effects for month of survey and clinic size category. Facilities were categorized by client population estimates as: small (<40,000 clients), medium (40,000-100,000 clients), and large (>100,000 clients).

Patient and Public Involvement

The parent study, focused primarily on improving the patient experience at routine clinic visits through HCW training, mentorship, and audit and feedback The research approach and content is based on participatory research with HCWs, human-centered design workshops, and stakeholder collaborations [23-29]. This research guided us to include measures of HCW satisfaction and wellbeing. In addition to a HCW experience measure throughout PCPH, the advent of COVID-19 led us to include an assessment of HCW depression. Patients were not directly involved in the design, nor the recruitment of this sub-study assessing the depression levels of HCWs. The

findings of this study as well as the parent study will be shared with the Zambian Ministry of Health as well as the study facilities.

Ethics

This study was approved as part of the larger PCPH study by the University of Zambia Biomedical Ethics Committee and the University of Alabama at Birmingham Institution Review Board, and the National Health Research Authority in Zambia. We obtained waiver of written informed consent and obtained verbal consent from participants prior to administering the survey.

Results

A total of 713 HCWs from 24 facilities across Lusaka and Chongwe districts in the Lusaka Province were included in the analysis dataset (**Table 1**). The majority (69.6%) of the PHQ-9 survey responses were collected in September 2020 (**Table 1**). The largest proportion of the responses were collected at facilities serving a large client population (41.7%) followed closely by facilities serving s medium-sized client population (37.7%) (**Table 1**). Responses for PHQ-9 questions were largely complete with <1% responses missing.

Table 1: Participant characteristics

Factor	Level	n (%)
N		713
Facility	1	30 (4.2)
	2	30 (4.2)
	3	30 (4.2)
	4	30 (4.2)
	5	30 (4.2)
	6	30 (4.2)
	7	30 (4.2)
	8	30 (4.2)
	9	30 (4.2)
	10	30 (4.2)
	11	30 (4.2)
	12	27 (3.8)
	13	27 (3.8)

	14	30 (4.2)
	15	30 (4.2)
	16	30 (4.2)
	17	30 (4.2)
	18	30 (4.2)
	19	30 (4.2)
	20	30 (4.2)
	21	30 (4.2)
	22	30 (4.2)
	23	29 (4.1)
	24	30 (4.2)
Clinic Population (category)	Small	147 (20.6)
	Medium	269 (37.7)
	Large	297 (41.7)
Month of Survey	August 2020	205 (28.8)
	September 2020	496 (69.6)
	October 2020	12 (1.7)

Of the 713 responses, 231 (32.4%, 95%CI: 29.0-36.0) reported mild depression (PHQ-9 score 5-9), 81 (11.4% 95%CI: 9.1-13.9) reported moderate depression (PHQ-9 score 10-14). A total of 81 (11.4) respondents had a PHQ-9 score corresponding to moderate depression across all but one facility, 17 (2.4%, 95%CI: 1.4-3.8) respondents had PHQ-9 scores consistent with moderately severe depression across four facilities, and five (0.7%, 95%CI: 0.2-1.6) HCWs had PHQ-9 scores consistent with severe depression across five different facilities (**Fig 1, Fig S1, Table 2**).

Table 2: Proportion of the analysis population by PHQ-9 score category with 95% confidence intervals (N=713)

Variable	*n*	*Proportion (%)*	*95% CI*
≥5 PHQ-9 score	334	46.8	(43.1, 50.6)
Mild	231	32.4	(29.0, 36.0)
Moderate	81	11.4	(9.1, 13.9)
Moderate-severe	17	2.4	(1.4, 3.8)
Severe	5	0.7	(0.2, 1.6)

Note: CI – confidence interval; PHQ-9 – nine-item patient health questionnaire.

Though we observed facility-level mental health heterogeneity in the proportion of minimal and mild depression scores across clinics, the proportion of scores consistent with moderate depression remain relatively stable across facilities (**Fig 1).**

Figure 1: A) Stacked bar chart of proportion population by PHQ-9 score category by health care facility B) Stacked bar chart of proportion population by PHQ-9 score by facility population size category.

Mixed effects adjusted Poisson regression model did not reveal clinic size or month of survey as a significant predictor of PHQ-9 score ≥5 (**Table 3**).

Table 3: Adjusted Poisson regression results (N=713)

Covariate	*level*	*aPR*	*95% CI*	*p-value*
Clinic Population (category)	small	1.12	(0.95, 1.33)	0.170
	medium	1.00 (ref)	ref	ref
	large	1.04	(0.81, 1.33)	0.763
Month of Survey	August	1.00 (ref)	ref	ref
	September	1.14	(0.94, 1.38)	0.193
	October	0.98	(0.54, 1.79)	0.945

Note: adjusted for survey week and facility

We illustrate significant heterogeneity in the marginal probability of experiencing greater than minimal depression across facilities (**Fig 2**). Notably, the highest marginal probability of HCWs with PHQ-9 score ≥5 was observed in a facility serving as a COVID-19 treatment center.

Figure 2: Marginal probability of health care worker with >minimal depression per PHQ-9 score by clinic.

Note: PHQ-9 – nine-item patient health questionnaire.

Discussion

We found that a large proportion of the HCW population had a PHQ-9 score ≥5 indicating a need for follow-up to assess and improve mental wellbeing 46.8% (95% CI: 43.1, 50.6%). Variation in

depression outcomes ranged from 82.7% (95% CI: 68.5, 96.9%) at one of the two large COVID-19 treatment facilities to 28.4% (95% CI: 13.0, 43.9%) at a medium-sized health care facility.

Our study shows that HCWs working at the COVID-19 treatment facility had a higher marginal probability of experiencing mild to moderately severe depression. This is consistent with past studies showing that frontline HCW working in clinics managing diseases considered to be highly infectious, such as COVID-19 treatment centers, were more prone to developing depression and other mental disorders than their counterparts in other departments [12]. In addition, results of our study demonstrate that HCWs have experienced symptoms of depression during the onset of the COVID-19 pandemic in Zambia, which is consistent with the findings of similar studies using the PHQ-9 in other parts of the world where a pooled prevalence of mild depression was found to be 36.1% (95% confidence interval [CI], 31.3%-41.0%) [30]. Studies conducted in Ethiopia among different cadres of HCWs show that mental disorders which include depression are prevalent among HCWs during the COVID-19 pandemic, with one study from Ethiopia identifying approximately 48% prevalence of greater than minimal depression, consistent with our Zambian estimates [31, 32]. Similarly, globally studies indicate that there is a risk of HCWs experiencing mental health disorders during the pandemic [4, 30, 31, 33]. The difficult conditions to which HCWs may be exposed including extended working hours, risk of exposure to the disease, increased workload, concerns about transmitting the infection to their family members, reduced social connectedness, and limited resources to care for their patients may amplify poor mental wellbeing [1, 34-36].

Further research is needed to understand heterogeneity in proportions of HCWs with depression. It may be associated variation in HCW access to resources such as, personal protective equipment (PPE), hand hygiene station/station supplies at clinic entrance, and knowledge about the COVID-19 response in Zambia. While the response to the COVID-19 pandemic was standardized, to a certain extent, by guidance from the provincial and zonal levels, the culture and leadership unique to each facility might have played a key role in the health care worker experience, contributing to PHQ-9 score distribution differences across facilities.

As we continue to recognize the mental health services gap across many populations in resource-limited settings we give evidence here to support prioritization of health care workers, especially during public health shocks/emergencies like that presented by COVID-19.Presenceof depression among HCWs could lead to poor health outcomes for the HCW workforce and have a sort of "knock-on" effect negatively impacting the quality of care provided to patients [37, 38]. Interventions like Friendship Bench piloted in neighboring Zimbabwe designed to encourage positive coping mechanism among HCWs and build a working environment that provides empathy and compassion towards staff may be an efficient option to provide mental wellness support [39, 40]. Furthermore, system-based interventions should also be encouraged such as change in working culture and reduction in possible system contributors to HCW stress that could lead to depression. Increasing mobile technology availability may further allow for the use of mobile health (mHealth) based mental wellness services leveraging the framework presented by Osei for low- and middle-income countries [41, 42]. Low-cost intervention packages used for patients can be adapted for HCWs and integrated into system-based interventions. They include routine screening for early detection, mental wellness education, problem solving and use of anti-depressants, cognitive behavior therapy which can be delivered successfully by trained lay HCWs [43, 44].

Limitations

This study had some potential limitations. Firstly, we did not collect participants demographics such as age, sex, marital status, and sex. As such we were not able to adjust for these co- founders. Accounting for these would help make associations in outcomes of depression. Secondly, we employed convenience sampling in selecting participants. This sampling approach may limit representativeness of study the results to the wider population of HCWs. Finally, without pre-COVID 19 estimates of depression among health care workers in Lusaka, we are not able to show association between mild-severe depression with the pandemic however, we show that during the pandemic that depression was high and attention to this population is justified to ensure a healthy HCW workforce. Additionally, though potentially highest than a non-pandemic baseline, these results may be useful as subsequent measures of depression and mental wellness are collected among HCWs.

Conclusions

Depression is a common public health problem; our study demonstrates that HCWs in Zambia may suffer from a high prevalence of depressive symptoms that will require additional clinical follow up. Routine mental health wellness is important to better understand the role that the COVID-19 pandemic may have had on depression among HCWS in Zambia. Furthermore, support for HCW mental wellness can serve to accelerate destigmatizing mental health issues and improve the quality of care provided across health care centers in Zambia.

Contributorship

SS: data collection, data Framing, and manuscript writing, JM, KS, and MM: data collection and data curation, LJ and CB: data framing, IS, CBM and EHG: conceptualization, AM: manuscript review/editing, AS: conceptualization and manuscript review/editing LKB: conceptualization, data analysis, data framing, and manuscript writing, JMP: data analysis lead, data framing, and manuscript writing. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Funding

Research reported in this publication was supported by the Bill & Melinda Gates Foundation grant number OPP1166485, the National Institute of Mental Health of the National Institutes of Health under award number F31MH109378 (L.K.B.), and the National Institute of Allergy and Infectious Diseases of the National Institutes of Health under award number K24 AI134413 (E.G.).

Competing of Interests

None

Ethical Approval

This study was approved as part of the larger PCPH study by the University of Zambia Biomedical Ethics Committee and the University of Alabama at Birmingham Institution Review Board, and the National Health Research Authority in Zambia. We obtained waiver of written informed consent and obtained verbal consent from participants prior to administering the survey.

Data Sharing

Extra data can be accessed via the Dryad data repository at http://datadryad.org/ with the doi: https://doi.org/10.25338/B8S646

Acknowledgements

We would like to thank the Zambian Ministry of Health for their leadership to ensure those in care continue to receive life-saving HIV treatment. We would also like to thank the health care

workers for their participation in the PHQ-9 assessment as well as their faithful delivery of care to patients in the face of the many challenges presented by the COVID-19 pandemic. To the clients seen at our study facilities we would like to extend sincere thanks for your cooperation and patience.

List of abbreviations [Optional]

ART: antiretroviral therapy

CI- Confidence Interval

COVID-19: Coronavirus Disease 2019

HCW: Health Care Worker

PCPH: Person- Centered Public Health for HIV Treatment in Zambia

PHQ-9: Patient Health Questionnaire 9

Data Sharing

Data used for this analysis is available through Dryad data repository (doi:10.25338/B8S646)

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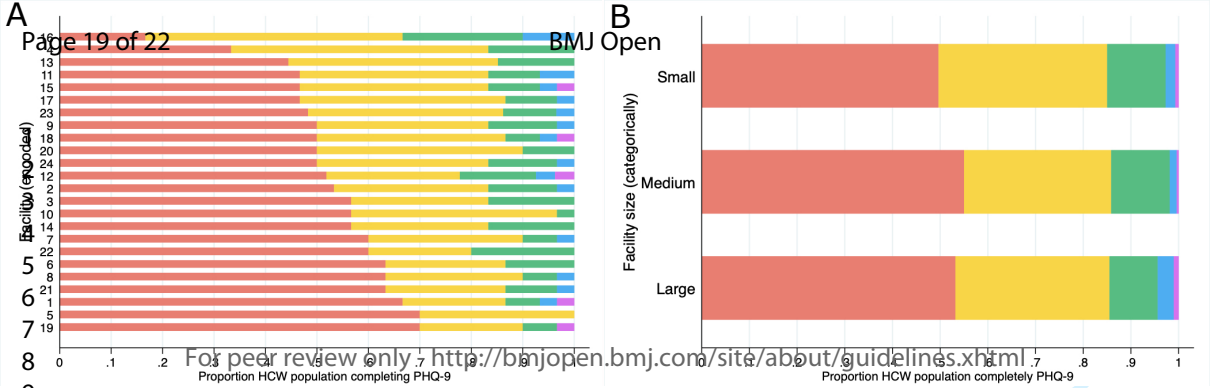
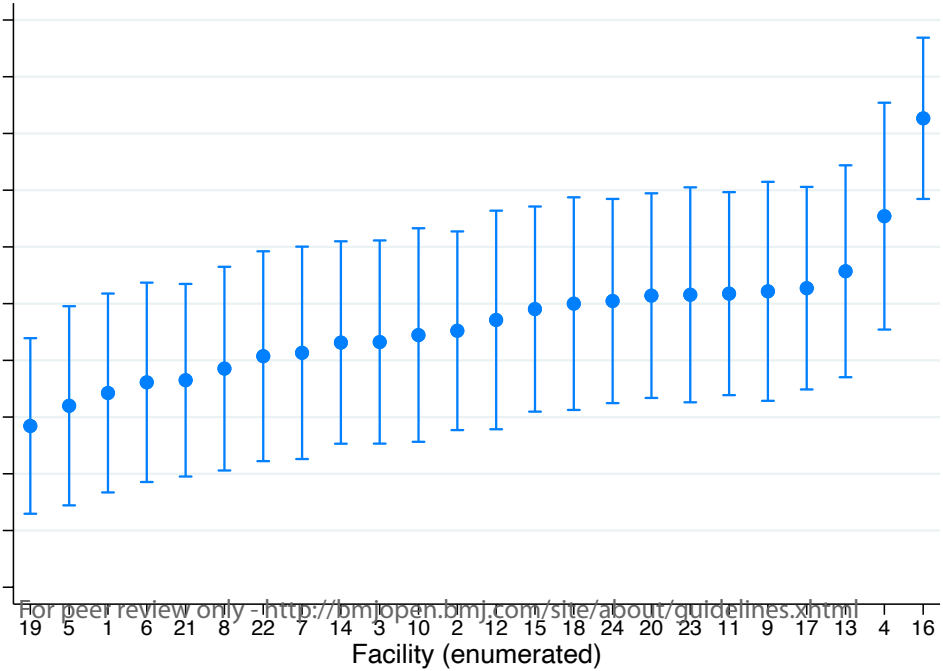
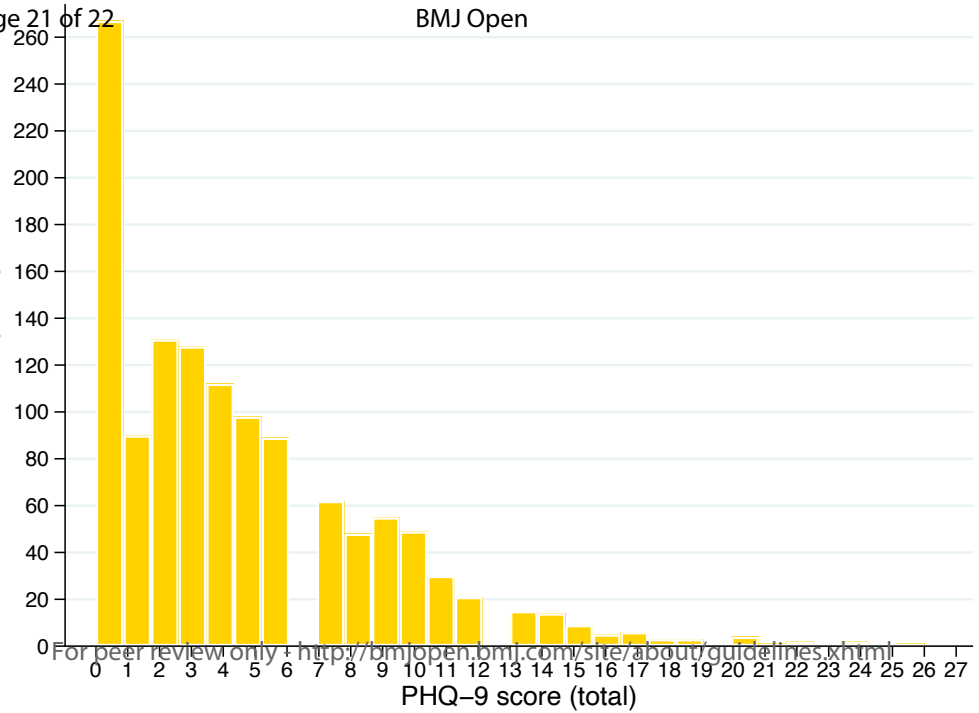
Supplement:

Figure S1: Histogram of total PHQ-9 scores among study participants







STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4, 5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5, 6
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5, 6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5, 6
Bias	9	Describe any efforts to address potential sources of bias	5, 6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5, 6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, explain how loss to follow-up was addressed	NA
		(*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7, 8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7, 8
		(b) Indicate number of participants with missing data for each variable of interest	7, 8
		(c) Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	Report numbers of outcome events or summary measures over time	7, 8

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	7, 8 7, 8 NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11, 12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9, 10
Generalisability	21	Discuss the generalisability (external validity) of the study results	9, 10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13, 14

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.