



A Longitudinal Study to Reexamine the Mental Health Impact on Radiation Oncology Health Care Workers with the Launch of COVID-19 Vaccination Strategies in India

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Abstract

Introduction The novel coronavirus disease 2019 (COVID-19) catastrophe caused significant mental threats to health care workers (HCW), especially during the first wave of the pandemic. India successfully implemented vaccination strategies in January 2021 that is likely to ameliorate the mental health impact of HCWs. The current survey aims to identify the change in impact following vaccination and address the issues affecting mental health.

Objective The primary objective is to reevaluate the stress levels of radiation oncology HCWs with vaccine implementation and compare it with the mental health status at the onset of the pandemic. The secondary objective is to identify the current causative factors influencing mental health.

Materials and Methods Health care workers who participated in the initial mental health impact survey at the outset of the COVID-19 pandemic from May to July 2020 were included in this study. Two hundred eligible HCWs were reassessed of the total 363 initial assessments. The 7-item Generalised Anxiety Disorder (GAD-7), 9-item Patient Health Questionnaire (PHQ-9), and 22-item Impact of Events Scale-revised (IES-R) was again served for assessing anxiety, depression, and posttraumatic stress disorder. The Mc Nemar test was

Keywords

- ▶ mental health
- ▶ radiation oncology
- ▶ COVID-19 vaccination
- ▶ anxiety
- ▶ depression
- ▶ stress

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used to evaluate the change and significance of the mental health impact. Univariate and multivariate analyses were done to identify the causative factors affecting mental health.

Results The cohort's median age was 30 years (interquartile range [IQR]: 27–33). The incidence of moderate-to-severe level anxiety, depression, and stress significantly declined to 6.5% ($p = 0.031$), 9% ($p = 0.01$), and 19% ($p < 0.001$) compared with 39.5, 40.5, and 30.5% during the pandemic onset. On further analysis, HCWs with affected family members had higher levels of stress ($p = 0.002$). The rest of the parameters did not have significant impact on mental health outcomes.

Conclusion With public education, awareness, and vaccination strategies, the second follow-up survey conducted after vaccine implementation demonstrated a significant number of HCWs in the radiation oncology community, exhibiting a decline in the incidence of anxiety, depression, and stress levels compared with the initial wave of the pandemic.

Introduction

The novel coronavirus disease 2019 (COVID-19) pandemic, a catastrophic health crisis witnessed in the 21st century, had adversely affected mental health across the globe.¹ The relentless increase in the number of cases and the unpredictable nature of this pandemic had further exacerbated the public's psychological distress.² In India, more than 4.3 crore cases have been identified so far, with above 5.2 lakh COVID-19-related deaths.^{3,4} The psychological impact of COVID-19 on humanity makes it imperative to address issues concerning mental health with a degree of urgency.⁵

Although there is an acute shortage of health workforce, we have nearly 5.76 million health care workers (HCWs).⁶ Mental stress had taken a toll on our HCWs during this critical period, affecting their professional and personal life. A few of the apparent reasons attributed were lengthy working hours, multiple shifts, risk of contracting the infection, transmitting it to family members back home, non-availability of personal protective equipment (PPE), isolation, quarantine, and segregation from families.⁷ In terms of availability of beds, our country has approximately 713,986 hospital beds across 25,778 hospitals in the government sector which is as low as 13.76 beds per 10,000 people.

During the first pandemic wave, more significant anxiety and panic was reported consequent to the rising number of fatalities and unavailability of a vaccine. Various studies were conducted on the deteriorating mental health condition of HCWs. HCWs from oncology and, especially, branches like radiation oncology, have more frequent contact and exposure to the patients due to the fractionated and prolonged course of treatment. A multinational study conducted in India from May 2020 to July 2020 with 758 participants of the radiation oncology fraternity, comprising various Asian countries revealed significant anxiety, depression, and stress levels in HCWs.⁸

With the rising number of cases and deaths, the public, including HCWs, was apprehensive about contracting the infection and the possibility of a next wave. The beginning of 2021 witnessed the approval of vaccines to fight the

pandemic that had caused untold misery and deaths across the globe.⁹ However, around 20 to 30% of the population were also apprehensive about the vaccine's side effects.¹⁰ India inaugurated its vaccination drive program on January 16, 2021.¹¹ Two vaccines were approved, the Covaxin which is an inactivated viral vaccine and Covishield which uses the viral vector platform. The country expedited its vaccination drive on a war footing, and 1 billion cumulative vaccine doses were administered by October 21, 2021.¹² This remarkable achievement was possible due to continued efforts from government agencies, vaccine manufacturers, and HCWs.

The ongoing vaccination drive, the resultant decrease in the severity of infections, and a marked fall in death rates are likely to have boosted the morale of most of our HCWs. On the other hand, the public was also apprehensive about the shortage of vaccines, their effectiveness, side effects, and the possibility of a second pandemic wave. We could see that a proportion of them was still unable to cope with the stress despite continued awareness and vaccine implementation. Hence, our study aimed to evaluate the change in the mental health status of radiation oncology HCWs following the mass vaccination drive in India and compare it with that at the beginning of the pandemic and identify the various causative factors negatively impacting their mental health.

Materials and Methods

This longitudinal study was conducted as a continuation of the survey done during the onset of the pandemic to re-explore the mental health status of HCWs with the advent of vaccine implementation strategies. The initial assessment from various Asian countries was published earlier this year.⁸ The data collection variables included demographic profile, history of COVID-19 contact, testing, and infection with vaccination status. Responses of the mental health assessment tools were analyzed. The case record form with all data variables is given in the **Supplementary Material S1** (available in the online version).

Participants

The mental health status of radiation oncology HCWs from four tertiary cancer care centers in India was assessed from January 2021 to May 2021. This period was chosen because the first wave of the pandemic was tailing down, and vaccination strategies for HCWs were just implemented and slowly picking up across the country. Participants were requested to fill out the survey via a google form. Three reminders were sent for completing the survey, and each question was marked mandatory to avoid missing data. The closure date for the response to the survey was fixed as May 10, 2021.

Inclusion and Exclusion Criteria

Our study included radiation oncology HCWs from India who filled the survey at the pandemic onset, aged 18 years and above. There was no cut-off for the upper age limit. The participants included radiation oncology clinicians, physicians, technologists, nurses, and allied workers. Participants who did not participate in the initial survey were excluded.

Data Collection

Of the 363 Indian participants who participated in the initial survey, 200 responses were received, forming the study sample for the current analysis. ► **Supplementary Fig. S1** (available in the online version) represents the number of participants evaluated during the first and second surveys. The demographic profile, including a history of vaccination status, was documented. The 7-item Generalised Anxiety Disorder (GAD-7), 9-item Patient Health Questionnaire (PHQ-9), and 22-item Impact of Events Scale-revised (IES-R) was again utilized for assessing anxiety, depression, and posttraumatic stress disorder. Univariate and multivariate analysis was done to identify the causative factors affecting mental health. No subgroup analysis was performed. For GAD-7, scores 0 to 4 represent minimal, 5 to 9 mild, 10 to 14 moderate, and 15 to 21 severe anxiety. For PHQ-9, scores 0 to 4 represent none, 5 to 9 mild, 10 to 14 moderate, 15 to 19 moderately severe, and 20 to 27 severe depression. For IES-R scores from 0 to 88, a total score of 24 or more for posttraumatic stress disorder is a clinical concern.^{13,14}

Statistical Analysis

Statistical Package for Social Sciences software, Version 25, was utilized for data analysis. The McNemar test was used to evaluate the change and significance of the mental health impact. Important causative factors for anxiety, depression, and stress were analyzed. Significant factors were entered into a multivariate Cox's proportional hazards model and expressed as hazard ratio (HR) with a 95% confidence interval (CI). A p -value of ≤ 0.05 was considered statistically significant.

Ethics

Tata Memorial Centre Institutional Ethics Committee approval was taken (project no: 3482, dated: May 13, 2020), and Clinical Trial Registry of India registration (CTRI no.: 2020/05/025212) was done before the initiation of the study.

Informed consent was obtained from all participants. The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1964, as revised in 2013.

Results

A total of 200 participants were assessed again for anxiety, depression, and stress. It was observed that 108 (54%) were married, 103 (51.5%) aged above 50 years, and 105 (52.5%) had less than three rooms in the household. Comorbidities were present in 26 (13%) participants. Among all the participants, 93 (46.5%) were physicians and 197 (98.5%) of HCWs had above secondary education. ► **Table 1** shows the demographic profile of the participants.

History of testing for COVID-19 and contracting the infection at any point of time during the pandemic was recorded for all study subjects. Overall, 113 (56.5%) of the participants got tested for COVID-19 among which 29 (14.5%) got infected. Also, 27 (93.1%) participants recovered from the infection by 2 to 4 weeks; however, two (7%) HCWs took nearly 4 to 6 weeks to recover. There was a total of 46 (23%) participants whose family members tested positive among whom 6 (13%) had both the participant and the family getting infected which was an important finding not usually asked in the questionnaire while evaluating mental health. About 152 (76%) of the participants had the facility for vaccination within the hospital itself. However, getting it done was voluntary, and 145 (72.5%) participants received at least one dose of the vaccine at the survey time. ► **Table 2** depicts the history of COVID-19 testing, infection, contact, and vaccination status for all participants.

The incidence of anxiety, depression, and stress levels were estimated in all the participants (► **Fig. 1**). It was noted that moderate-to-severe level was seen in 13 participants (6.5%), moderate-to-severe depression in 18 participants (9%), and moderate-to-severe stress in 38 (19%). It was noticed that the adverse impact on mental health had a decreasing trend during the span of vaccine implementation compared with the survey done at the beginning of the pandemic. ► **Fig. 2** shows the change in the levels of anxiety, depression, and stress that changed over the course of the pandemic. The levels of moderate-to-severe anxiety decreased from 39.5 to 6.5% ($p=0.03$), depression from 40.5 to 9% ($p=0.001$), and stress levels from 30.5 to 19% ($p<0.001$). Following precautions for personal protection, health education about the transmission of infection, public awareness, and vaccine implementation is likely to have contributed to change in mental health status over time.

Univariate analysis was done to assess the factors which determine anxiety, depression, and stress levels. It was seen that none of the factors was significant for anxiety and depression among all. However, for stress levels, COVID-19 infection among family members significantly contributed to increased stress levels ($p=0.002$). ► **Table 3** shows the univariate analysis for stress. The tables of univariate analysis for anxiety and depression are shown in the

Table 1 Demographic profile of all participants

Participants		n = 200	
Median age [IQR] in years		30	[27–33]
		n	%
Gender	Female	87	43.5
	Male	113	56.5
Marital status	Divorced or separated	1	0.5
	Married	108	54.0
	Single	91	45.5
Number of rooms in the household	<3	105	52.5
	≥3	95	47.5
Children less than 15 years	0	135	67.5
	1	44	22.0
	≥2	21	10.5
Age more than 50 years	No	97	48.5
	Yes	103	51.5
Occupation	Administrator	3	1.5
	Allied health care worker	20	10.0
	Nurse	4	2.0
	Physician	93	46.5
	Physicist/therapist	80	40.0
Cadre	Junior staff (<10 years' experience)	124	62.0
	Senior staff (>10 years' experience)	26	13.0
	Student	50	25.0
Comorbidities	No	174	87.0
	Yes	26	13.0
History of smoking or tobacco use	No	191	95.5
	Yes	7	3.5
	Do not want to disclose	2	1.0
Educational qualification	Above secondary	197	98.5
	Below secondary	3	1.5

Abbreviations: COVID-19, novel coronavirus disease 2019; IQR, interquartile range.

► **Supplementary Tables 1 and 2** (available in the online version).

Discussion

The COVID-19 pandemic has undoubtedly impacted the mental health of a significant proportion of the population. A survey conducted in the United States revealed that 4 in 10 adults reported anxiety or depressive disorder, compared with 1 out of 10 in the prepandemic era.¹⁵ Conspicuous factors impacting mental health include fear of getting infected, isolation, quarantine for long periods, lack of social life and financial burden. As the pandemic unfolded, individuals at a high risk of psychological stress were the frontline workers, including doctors, nurses, community health workers, sanitation

workers, police personnel, and others. They relentlessly provided care and assistance to the affected needy as the pandemic raged across the country.¹⁶ Long working hours, multiple shifts, fear of transmitting the contagion to family members, and inadequacy of emergency medical equipment, including PPEs, manifestly exacerbated the stress level during the initial wave of the pandemic, even as the unprecedented lockdowns derailed the health care system across the world.¹⁷

Cancer care was affected during the pandemic across the globe and in India.^{18,19} Despite grave challenges, the center delivered uninterrupted cancer care services.²⁰ At the onset of the pandemic, a multinational survey was conducted across Asian countries to assess the anxiety, depression, and stress levels among HCWs in the radiation oncology community from May to July 2020. The study revealed

Table 2 History of COVID-19 testing, infection, contact, and vaccination status

		n (200)	%
Close contact	No	40	20.0
	Yes	160	80.0
Place of Contact	Society	13	8.1
	Workplace	138	86.3
	Other	9	5.6
Testing for COVID-19	No	87	43.5
	Yes	113	56.5
COVID-19 positive	No	171	85.5
	Yes	29	14.5
Weeks for recovery	2 to 4	27	93.1
	4 to 6	2	6.9
Family members contracted COVID-19	No	154	77.0
	Yes	46	23.0
HCW and family +ve	Yes	6/46	13
Vaccination facility	No	48	24.0
	Yes	152	76.0
Volunteering to get vaccinated	No	55	27.5
	Yes	145	72.5

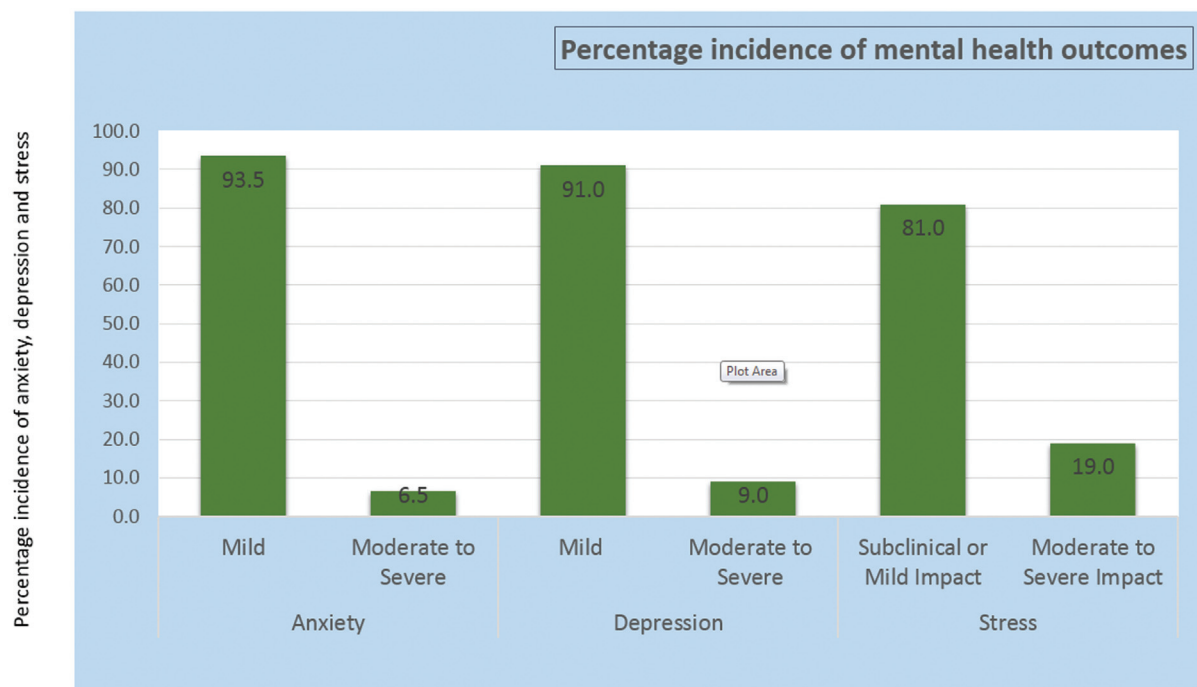
Abbreviations: COVID-19, novel coronavirus disease 2019; HCW, health care worker.

significant levels of anxiety (34.8%), depression (31.2%), and stress (18.2%) among HCWs.⁸

The current analysis of 200 participants across various tertiary cancer care centers in India shows that 80% had close contact with a COVID-19-positive patient, with 86% at the workplace. A surge in COVID-19-positive patients within the hospital was seen as cancer patients were a vulnerable group to contracting infection consequent in decreased overall immunity. The hospital policy did not insist on testing asymptomatic patients who visited the institution daily for radiation treatment.²¹ However, patients posted for brachytherapy procedures were routinely tested. This aggravated the existing case burden for COVID-19. Around 14.5% of the HCWs tested positive, and nearly 7% tested free from the virus after 4 to 6 weeks. The more prolonged periods of isolation had impacted mental health.

As the year came to a close, vaccines were developed in various countries. In December 2020, the U.S. Food and Drug Administration issued the first emergency use authorization (EUA) for a vaccine for the prevention of COVID-19 in individuals 16 years of age and older.²² India's COVID-19 vaccination drive commenced in the middle of January with the approval of Covishield and Covaxin vaccines for restricted emergency use.²³ HCWs of our country were among the first to receive the vaccine doses.²⁴ Also, 76% of the participants had access to vaccination centers within the hospital itself.

As the vaccination program commenced, there was skepticism among a minority of the public on whether to get vaccinated or not. This is a natural corollary to the media reports on the efficacy and side effects of various parts of the world. In March 2021, the Danish Health Authority reported severe cases of blood clots with the Vaxzevria COVID-19

**Fig. 1** Percentage incidence of mental health outcomes during second survey.

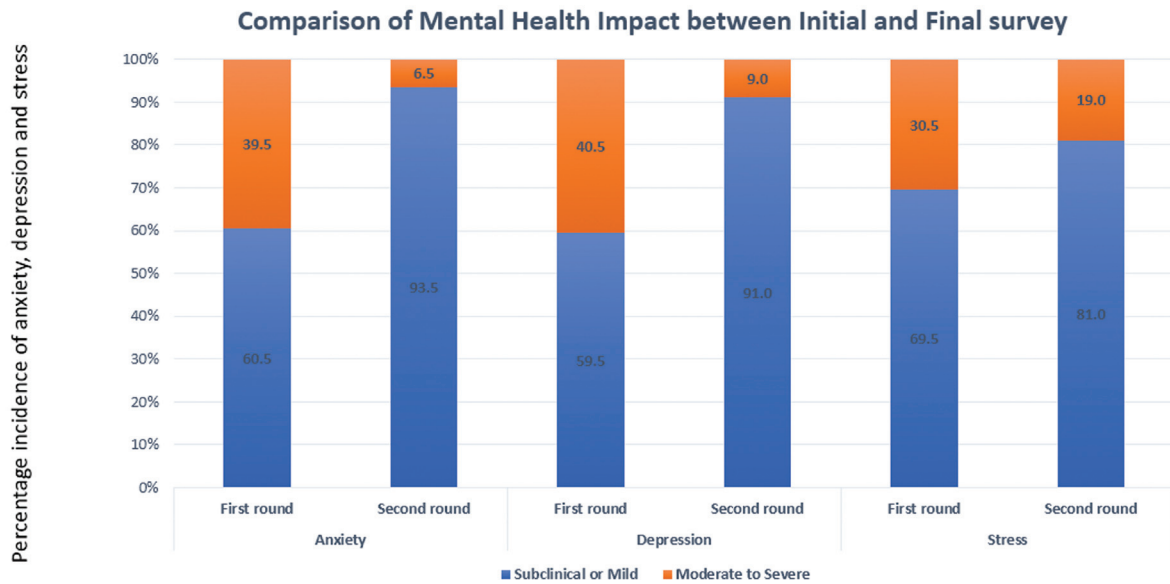


Fig. 2 Comparison of mental health impact between initial and final survey.

Table 3 Univariate analysis for stress levels

Variables to assess the change in impact		Mild Impact (n = 162) n (%)	Mild-to-severe Impact (n = 38) n (%)	p-Value
Median age [IQR] in years		29.5 [27–33]	30 [28–34.25]	0.118
Gender	Female	72 (82.8)	15 (17.2)	0.578
	Male	90 (79.6)	23 (20.4)	
Marital status	Divorced or separated	1 (100.0)	0 (0.0)	0.881
	Married	87 (80.6)	21 (19.4)	
	Single	74 (81.3)	17 (18.7)	
No. of rooms in household	<3	87 (82.9)	18 (17.1)	0.482
	≥3	75 (78.9)	20 (21.1)	
Children in the house <15 years	0	110 (81.5)	25 (18.5)	0.837
	1	36 (81.8)	8 (18.2)	
	2	16 (76.2)	5 (23.8)	
Adults >50 years	0	84 (86.6)	13 (13.4)	0.05
	≥1	78 (75.7)	25 (24.3)	
Occupation	Administrator	3 (100.0)	0 (0.0)	0.437
	Allied health care worker	19 (95.0)	1 (5.0)	
	Nurse	3 (75.0)	1 (25.0)	
	Physician	73 (78.5)	20 (21.5)	
	Physicist/therapist	64 (80.0)	16 (20.0)	
Cadre	Junior staff	98 (79.0)	26 (21.0%)	0.335
	Senior staff	20 (76.9)	6 (23.1)	
	Student	44 (88.0)	6 (12.0)	
Comorbidities	No	140 (80.5)	34 (19.5)	0.791
	Yes	22 (84.6)	4 (15.4)	
Smoking	No	154 (80.6)	37 (19.4)	0.746

Table 3 (Continued)

Variables to assess the change in impact		Mild Impact (n = 162) n (%)	Mild-to-severe Impact (n = 38) n (%)	p-Value
	Yes	6 (85.7)	1 (14.3)	
	Do not want to disclose	2 (100.0)	0 (0.0)	
Educational qualification	Above secondary	161 (81.7)	36 (18.3)	0.093
	Below secondary	1 (33.3)	2 (66.7)	
Close contact	No	33 (82.5)	7 (17.5)	0.787
	Yes	129 (80.6)	31 (19.4)	
COVID-19 testing	No	71 (81.6)	16 (18.4)	0.847
	Yes	91 (80.5)	22 (19.5)	
COVID-19 positivity	No	139 (81.3)	32 (18.7)	0.802
	Yes	23 (79.3)	6 (20.7)	
COVID-19 in family members	No	132 (85.7)	22 (14.3)	0.002
	Yes	30 (65.2)	16 (34.8)	
Vaccination facility	No	35 (72.9)	13 (27.1)	0.102
	Yes	127 (83.6)	25 (16.4)	
Volunteering for Vaccine	No	43 (78.2)	12 (21.8)	0.532
	Yes	119 (82.1)	26 (17.9)	
Longer period of isolation				

Abbreviations: COVID-19, novel coronavirus disease 2019; IQR, interquartile range.

vaccine. There were also isolated cases of a neurological disorder, such as Guillain-Barré syndrome, in scarce vaccinated people.^{25,26} There were also doubts regarding the vaccine's effectiveness against the mutating variants of the virus. This could be the reason that why 27.5% of the participants abstained from vaccination at the time of the survey.²⁷

In April 2021, India witnessed a second pandemic wave with more than 6.9 million new cases and 48,000 deaths.²⁸ India administered more than 84 million vaccine doses, an average of 2.8 million per day in April 2021. Our second survey project reassessed the mental impact among the same subset of radiation oncology HCWs from India who participated in the initial questionnaire. They revealed decreasing anxiety, depression, and stress levels compared with the initial survey. This was primarily due to greater preparedness of the government, health care system and growing confidence of the people in combating the pandemic. Vaccines had brought optimism, and fatalities had decreased concomitantly, reducing the severity of the infection. Continued awareness about safety precautions and compliance also contributed to the positive mental health impact continuum.

Several studies reported a positive impact on mental health following vaccine implementation in various parts of the world. In an extensive survey of 453,167 volunteers from the United States, vaccinated participants had a 13% lower risk of developing anxiety and 17% lower risk of depression than nonvaccinated patients. In another survey

from the United States, vaccination was associated with declines in distress and perceived dangers of infection, hospitalization, and death. In another large study of 8,003 adults who were vaccinated between December 2020 and March 2021, decreased mental distress levels were reported after receiving the first dose.²⁹⁻³¹

In our study, in univariate analysis, none of the demographic factors impacted anxiety or depression. However, COVID-19 among the family members was significant ($p = 0.002$) in affecting stress levels. HCWs were perennially in fear of infecting their families.^{32,33} Social stigma was an important concern during the pandemic. Several incidents of stigmatization were reported against frontline workers. Families of HCWs were subjected to social quarantine as they were also considered a contagion source.³⁴ Many health professionals lived away from families during the pandemic. If a family member gets COVID-19, it is likely to be more stressful; one of the main concerns for the HCWs is that the infection may have been transmitted from their workplace. Spread among other members, especially elderly parents, joint families, and societies, shutting down essential services for the affected household could further aggravate the distress.

In an attempt to improve the mental health of the HCWs, mass counseling sessions were organized within the center by psychologists leading to positive results. Subjects with acute psychological distress were also given individual counseling. Our center also addressed mental health concerns during this period with professional support. The services offered included counseling and psychotherapy for various problems like

anxiety, loneliness, relationship issues, difficulty sleeping, depression, trauma, self-harm, and others. It was also made sure that all counseling sessions were strictly confidential. These sessions are held weekly through online platforms for easy accessibility for all participants.

Creating awareness and persistent measures to educate the people paid rich dividends in significantly reducing the levels of moderate-to-severe anxiety, depression, and stress among HCWs in the radiation oncology community. In general, it can be interpreted that the mental impact after vaccination strategies were implemented, vis a vis, the second wave was better compared with the first. In one of the recent studies, it was seen after 12 weeks of the double dose of vaccine. These measures, along with the decreasing trend of COVID-19 fatalities and fall in severe infections, have generated hope that our fraternity's mental health and well-being will improve in due course of time.

Limitations and Strengths

Our study had several limitations. Out of the 363 participants who were surveyed at the first pandemic wave, only 200 could complete the present one. This was mainly because of the long gap between the two surveys wherein many participants had changed the workplace. At the time of the survey, vaccination strategies were just getting implemented, and the public had doubts regarding the safety and efficacy. This could also have possibly impacted the response rate. The stress among the participants was higher during the initial months of the pandemic, especially with an increase in case fatalities and nationwide lockdowns; however, with increased public awareness, compliance to precautionary measures, and ease of restrictions, results may have been confounded.

This study highlights the importance of studying the mental health of HCWs during the pandemic, as the psychological footprint of a disaster is supposedly more prominent than the medical footprint. Effective corrective actions should be implemented to provide a safe work environment that will facilitate work-life balance, effective communication, and information, health promotion, job security, and lend risk-adapted psychosocial support.

Conclusion

Continued health education, compliance to safety precautions and effective vaccination strategies have produced beneficial results. The second survey conducted at the launch of vaccine implementation strategies showed that a significant number of HCWs in the Radiation Oncology community had declining trends of anxiety, depression, and stress levels compared with the pandemic's initial wave.

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Conflict of Interest

None declared.

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