



A pre-post study of stressors and burnout affecting breast radiologists before and during the COVID-19 pandemic[☆]

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ABSTRACT

Rationale and objective: To compare burnout and stressors of breast radiologists prior to and during the COVID-19 pandemic.

Materials and methods: Members of the Society of Breast Imaging were emailed an IRB-approved survey in January 2021 during the COVID-19 pandemic. Survey included questions from the Maslach Burnout Inventory and specific stressors including work pace, work-life balance, care of dependents, and financial strain. Data were compared to previous surveys prior to the pandemic.

Results: The response rate was 25% (261/1061) for those who opened the email. Of the respondents, 74% (194/261) were female, 82% (214/261) were white, 73% (191/261) were full time, 71% (185/261) were fellowship trained, 41% (106/261) had more than 20 years of experience, and 30% (79/261) were in academic practice. Respondents in 2021 reported frequent levels of depersonalization (2.2) and emotional exhaustion (3.4) while reporting frequent levels of personal accomplishment (5.3), a protective factor. These values were nearly identical before the pandemic in 2020: (2.2, 3.5, 5.3, respectively, $p = .9$). Respondents rated practicing faster than they would like as the highest stressor; however, 5 of the 6 stressors improved after the pandemic onset ($p < .05$). Conversely, participants perceived these stresses had gotten slightly worse since the pandemic ($p < .01$). Almost 50% of respondents reported they were considering leaving their practice; the most common reason was work/life balance.

Conclusion: Burnout in breast radiologists remains frequent but unchanged during the COVID-19 pandemic. While participants perceived that some stressors were worse during the pandemic, there was slight improvement in most stressors between the pre-pandemic and pandemic cohorts.

1. Introduction

The World Health Organization defines burnout as a syndrome resulting from chronic workplace stress that has been unsuccessfully

managed [1]. It is characterized by 3 fundamental dimensions – (1) feelings of energy depletion or exhaustion, (2) increased mental distance from one's job, and (3) a sense of ineffectiveness and lack of accomplishment [1,2]. Physician burnout has been associated with multiple

Abbreviations: IRB, Institutional review board; SBI, Society of breast imaging; MBI, Maslach burnout inventory; NC, North Carolina; GLM, Generalized linear modeling; AL, Allostatic load.

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adverse physician outcomes including mental issues [3], suicidal ideation [4], and substance abuse [5]; negative workplace metrics including job dissatisfaction [6], reduced productivity [7], and higher intention to leave [8]; and suboptimal measures related to patient quality and safety [9,10]. Multiple peer-reviewed studies within the United States prior to the COVID-19 pandemic have reported a prevalence of radiologist burnout higher than other physicians [11,12]. Similar to other specialties of radiology [13–16], there is high prevalence of burnout amongst breast radiologists [17]. The stressors affecting breast radiologists [18] overlap but appear to be different from other radiology subspecialties [19].

The onset of the COVID-19 pandemic impacted the practice of radiology. Initially, there was dramatic decrease in operational volumes [20], with associated adverse financial outcomes [21], but this was ultimately followed by a rebound effect with multiple practices contending with backlogs of patient studies [22]. Superimposed upon these operational challenges were multiple life-related challenges which have disproportionately affected women, including childcare responsibilities [23,24], homeschooling [25], and working from home with multiple interruptions [25]. In the academic environment, there are concerns of reduced productivity in women [26] which may ultimately translate to delayed academic promotion in female radiologists [27]. Authors have advocated for increased support of female radiologists during the COVID-19 pandemic [22].

The majority of practicing breast radiologists are women [28]. A recently published survey documents subjective self-reported stressors affecting breast radiologists following COVID-19 [29]. With the stresses from COVID-19 reportedly disproportionately affecting females, we hypothesized that burnout would have worsened in breast radiologists during the COVID-19 pandemic relative to the prior year. The purpose of the present study was to objectively compare burnout factors and stressors affecting breast radiologists during the COVID-19 pandemic compared to the year prior to COVID-19.

2. Materials and methods

This study was exempt from ongoing evaluation by the (anonymized) Institutional Review Board.

The Society of Breast Imaging (SBI) is the largest organization of dedicated practicing breast radiologists in the United States. The radiologist member list and associated Email addresses are confidentially maintained by the SBI; the study authors did not have access to this information.

A survey was prepared and structured in SurveyMonkey (San Mateo, CA). The anonymous surveys included basic demographic questions from the Annual Workforce Surveys conducted by the American College of Radiology Commission on Human Resources [30,31], self-reported items from the Maslach Burnout Inventory [32] and specific stressors [18]. Questions were derived from previous surveys [17,18]. Stressors evaluated included work-pace, work-life balance, care of dependents, financial strain, job security, working in medicine. Actively practicing members of the SBI within the United States received an Email from the SBI inviting them to voluntarily complete the survey without recording their Email addresses. Email invitations were sent on January 14, 2021 and January 25, 2021. The survey was closed on 02/22/2021. Data were collected using REDCap; the SBI did not have access to these responses. The design was an (unexpected) pre-post design where SBI members' responses during COVID-19 were compared to previous studies from 2019 and 2020 [17,18].

All analyses were conducted using SAS Software 9.4 (SAS Inc. Cary, NC). Burnout and stressors items were modeled over time using generalized linear modeling (GLM) using the GLIMMIX procedure. A multi-variable GLM model was examined using gender (female by male) as a moderator. Alpha was established a priori at the 0.05 level and all interval estimates were calculated for 95% confidence. Multiple comparisons were adjusted using the Bonferroni method.

3. Results

3.1. Demographics

For 2021, 2410 emails were sent with 1061 opened emails, and 261 responded: thus, the response rate was 25% (261/1061) for those who opened the email. The demographics and response rates for 2019 and 2020 were reported previously [17,18]. As summarized in Table 1, the respondents were predominately female, white, were employed full time, and were fellowship trained. Many respondents had more than 20 years of experience and were primarily in either private or academic practice. Table 2 shows the geographic distribution and practice patterns of the respondents.

3.2. Stressors

As seen in Table 3 and Fig. 1, respondents largely disagreed that financial strain, job security, and wanting to work outside of medicine were stressors, regardless of year. However, during 2020, respondents reported financial strain and job security as significantly lower stressors compared to 2019. Likewise, respondents reported providing care for dependents was significantly lower stressor in 2020 than in 2019. Although respondents agreed that having to practice faster because of high volume and trying to balance work-life demands were the highest

Table 1
Respondent Demographics.

	Count	%
Age		
< 35	10	3.9
36–45	90	34.6
46–55	52	20.0
56–65	88	33.9
> 65	20	7.7
Gender		
Male	64	24.7
Female	194	74.9
Other	1	0.4
Race		
White - A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.	214	82.6
Black or African American - A person having origins in any of the Black racial groups of Africa.	5	1.9
Asian - A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.	36	13.9
Other	4	1.5
Ethnicity		
Not Hispanic, Latino, or Spanish origin	218	86.9
Other	18	7.2
Latino, or Spanish Origin - A person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race.	15	6.0
Fellowship		
No	75	28.9
Yes	185	71.2
Postgraduate residency and / or fellowship training?		
5 years or less	47	18.1
6–10 years	46	17.7
11–20 years	61	23.5
21 years or more	106	40.8
Do you work full time or part time?		
Full-time	191	73.2
Part-Time	70	26.8

Table 2
Practice Demographics.

	Count	%
Region		
Mid-Atlantic (DE, MD, NJ, NY, PA)	40	15.3
Midwest (IN, IL, MI, OH, WI, IA, KS, MN, ND, SD)	50	19.2
New England (CT, ME, MA, NH, RI, VT)	31	11.9
South (FL, GA, NC, SC, AL, KY, MS, TN, AR, LA, DC, VA, WV, MO)	69	26.4
Southwest (AZ, NM, OK, TX)	34	13.0
West (CO, ID, MT, UT, NV, WY, AK, CA, HI, OR, WA, NE)	37	14.2
How many radiologists practice in your organization or group?		
a) Fewer than 5	29	11.2
b) 6–10	34	13.1
c) 11–20	57	21.9
d) 21–50	71	27.3
e) > 50	69	26.5
Which best describes your call responsibilities?		
No nights or weekends	103	39.8
General radiology call nights and/or weekends	106	40.9
Breast imaging responsibilities on nights and/or weekends	50	19.3
Primary Practice Type		
Hospital	42	16.1
Academic University	79	30.3
Multispecialty Clinic	16	6.1
Private Practice	116	44.4
Corporate Employee	7	2.7
Government (VA or Military)	1	0.4
Percentage of your practice is breast imaging		
0–25%	10	3.9
26–50%	22	8.5
51–75%	48	18.5
76–100%	180	69.2

Table 3
Self-Reported Stressors and burnout.

Stressors (1) Disagree Strongly to (6) Agree Strongly	2019		2020		P-value
	Mean	95% CI	Mean	95% CI	
1 My current financial situation is a serious strain.	1.2	[1.1 1.4]	1.0	[0.8 1.1]	0.001 *
2 The prospect of losing my job or not finding a suitable job is a major source of stress in my life.	1.4	[1.3 1.6]	1.1	[1.0 1.3]	0.011 *
3 I wish I worked outside of medicine.	1.4	[1.2 1.5]	1.4	[1.2 1.5]	0.83
4 Providing, organizing, or paying for care for dependents is a major source of stress in my life.	2.0	[1.9 2.1]	1.7	[1.6 1.9]	0.0034 *
5 Working in medicine is a major source of stress in my life			2.4	[2.2 2.5]	
6 Having to work more hours than I would like is a major source of stress in my life			2.5	[2.3 2.6]	
7 Having to practice faster than I would like because of a high volume of work is a major source of stress in my life	2.9	[2.7 3.0]	2.6	[2.5 2.8]	0.011 *
8 Trying to balance the demands of my work with the time needed for my personal and family life is a major source of stress.	2.7	[2.6 2.9]	2.5	[2.4 2.7]	0.038 *
Burnout Constructs					
	Mean	95% CI	Mean	95% CI	P-Value
(1) Never, (3) Monthly, (4) Weekly, (2) (6) Many times per day					
1 Depersonalization	2.2	[2.0 2.4]	2.2	[2.0 2.4]	0.68
2 Emotional Exhaustion	3.5	[3.3 3.6]	3.4	[3.3 3.6]	0.94
3 Personal Accomplishment	5.3	[5.2 5.3]	5.3	[5.2 5.3]	0.97
Worsening Stressor					
(1) Improved, (1) Stayed the Same, (2) (2) Worsened			Mean	95% CI	
1 My current financial situation is a serious strain.			1.2	[1.1 1.3]	
2 The prospect of losing my job or not finding a suitable job is a major source of stress in my life.			1.2	[1.1 1.2]	
3 I wish I worked outside of medicine.			1.1	[1.1 1.2]	
4 Providing, organizing, or paying for care for dependents is a major source of stress in my life.			1.2	[1.2 1.3]	
5 Working in medicine is a major source of stress in my life			1.3	[1.3 1.4]	
6 Having to work more hours than I would like is a major source of stress in my life			1.3	[1.2 1.4]	
7 Having to practice faster than I would like because of a high volume of work is a major source of stress in my life			1.2	[1.1 1.3]	
8 Trying to balance the demands of my work with the time needed for my personal and family life is a major source of stress.			1.3	[1.2 1.4]	

stressors regardless of year, respectively, they too were significantly lower stressors in 2020 compared to 2019. Working in medicine, working more hours than liked, having to practice faster because of high volume, and trying to balance work-life demands were all rated as stressors on average. There was no evidence that these results differed between identified gender by year ($p = .9712$), though women significantly agreed more with question 4 “Providing, organizing, or paying for care for dependents is a major source of stress in my life” then men for both 2019 (3.2, 95% CI [3.1, 3.4] vs. 2.2, 95%CI [1.8, 2.5]), $p < .01$) and 2020 (2.8, 95% CI [2.5, 3.1] vs. 2.0, 95% CI[1.6, 2.5], $p = .04$) (see Fig. 4).

On the other hand, as seen in Fig. 2 and Table 3, respondents perceived all these stressors had gotten slightly worse since the pandemic ($p < .001$). Although there was no evidence that these results differed between identified gender ($p = .73$), women significantly reported question 4 “Providing, organizing, or paying for care for dependents is a major source of stress in my life” had worsen more than men (1.3, 95% CI[1.2, 1.4] vs. 1.1, 95% CI[1.0, 1.2], $p = .018$) (see Fig. 5).

3.3. Burnout

As seen in Table 3, for 2020, respondents reported levels of depersonalization that were, on average, once a month or less (i.e. 2) (2.2, 95% CI [2.0, 2.4]) and emotional exhaustion between a few times a month (i.e. 3) and every week (i.e. 4) (3.4, 95% CI [3.3, 3.6]). Personal accomplishment, a protective factor was, on average, everyday (5) to several times per day (6) (5.3, 95% CI[5.2, 5.3]). These values were almost identical for 2019. There was no evidence that these results differed between identified gender by year ($p = .09$).

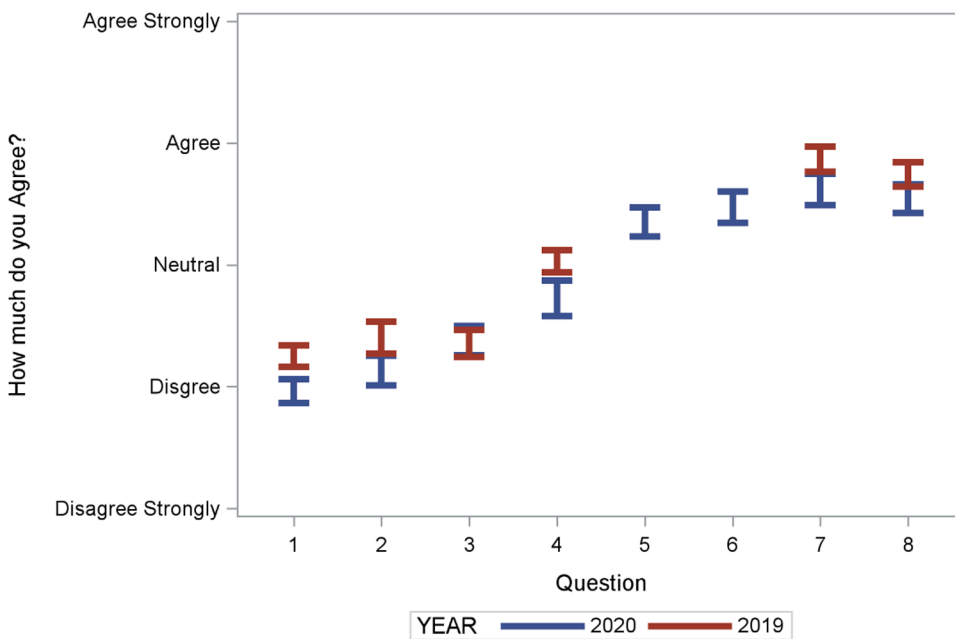


Fig. 1. Stressors for 2019 compared to 2020. Note: Y-axis is Disagree Strongly (0) to Agree Strongly (6); Red is 2019, Blue is 2020 with 95% confidence intervals. X-axis is stressor question 1–8 and are as follows: 1. My current financial situation is a serious strain. 2. The prospect of losing my job or not finding a suitable job is a major source of stress in my life. 3. I wish I worked outside of medicine. 4. Providing, organizing, or paying for care for dependents is a major source of stress in my life. 5. Working in medicine is a major source of stress in my life 6. Having to work more hours than I would like is a major source of stress in my life 7. Having to practice faster than I would like because of a high volume of work is a major source of stress in my life 8. Trying to balance the demands of my work with the time needed for my personal and family life is a major source of stress.

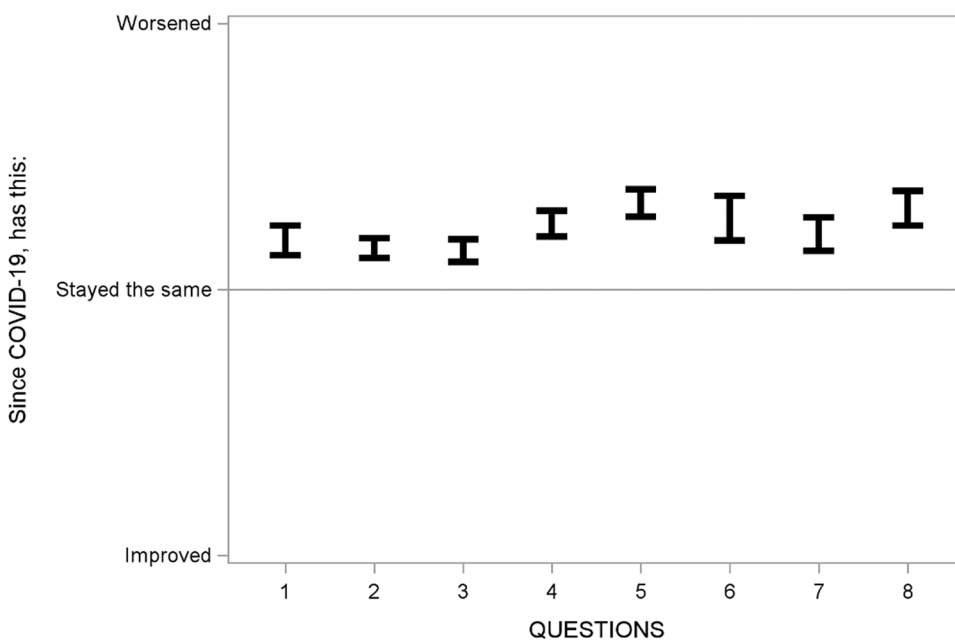


Fig. 2. Worsening Stressors During COVID-19. Note: Y-axis is Improved (0) to Worsened (2) with 95% confidence intervals. X-axis is stressor question 1–8 and are as follows: 1. My current financial situation is a serious strain. 2. The prospect of losing my job or not finding a suitable job is a major source of stress in my life. 3. I wish I worked outside of medicine. 4. Providing, organizing, or paying for care for dependents is a major source of stress in my life. 5. Working in medicine is a major source of stress in my life 6. Having to work more hours than I would like is a major source of stress in my life 7. Having to practice faster than I would like because of a high volume of work is a major source of stress in my life 8. Trying to balance the demands of my work with the time needed for my personal and family life is a major source of stress.

3.4. Burnout and Stress

As seen in Fig. 3, as the level of agreement for each stressor increases, the odds of an increase for self-reported burnout (emotional exhaustion) also increase: Financial strain (1): OR: 1.2, 95% CI [1.1, 1.4], Job security (2) OR: 1.2, 95% CI [1.1,1.4], wish to work outside medicine (3) OR: 1.6, 95% CI [1.4, 1.8], Care for dependents (4) OR: 1.1, 95% CI [1.0,1.2], working in medicine (5) OR: 1.8, 95% CI [1.6, 2.0], too many hours (6) OR: 1.5, 95% CI [1.4, 1.7], practice faster than like (7) OR: 1.4, 95% CI [1.3,1.6], and work-life balance (8) OR: 1.6, 95% CI [1.4, 1.8], all $p < .05$. There was no evidence that these results differed between identified gender by year ($p = .71$) (see Fig. 6).

3.5. Reasons of Leaving

Nearly half (130/261, 49.8%) of respondents reported they were considering leaving their current practice. The most common reason for leaving was work/life balance (82/130, 63%) follow by clinical workload (65/130, 50%) and interpersonal/cultural issues (44/130, 34%). Of the 130 thinking of leaving, 61% were leaving for two or more reasons (Table 4). As shown in Table 5, only “Other” differed by gender (15% (women) vs. 5% (men), $p = .03$).

4. Discussion

Our study indicates that both before and during the pandemic there were persistent levels burnout amongst practicing breast radiologists within the United States. Using various assessment tools, the prevalence

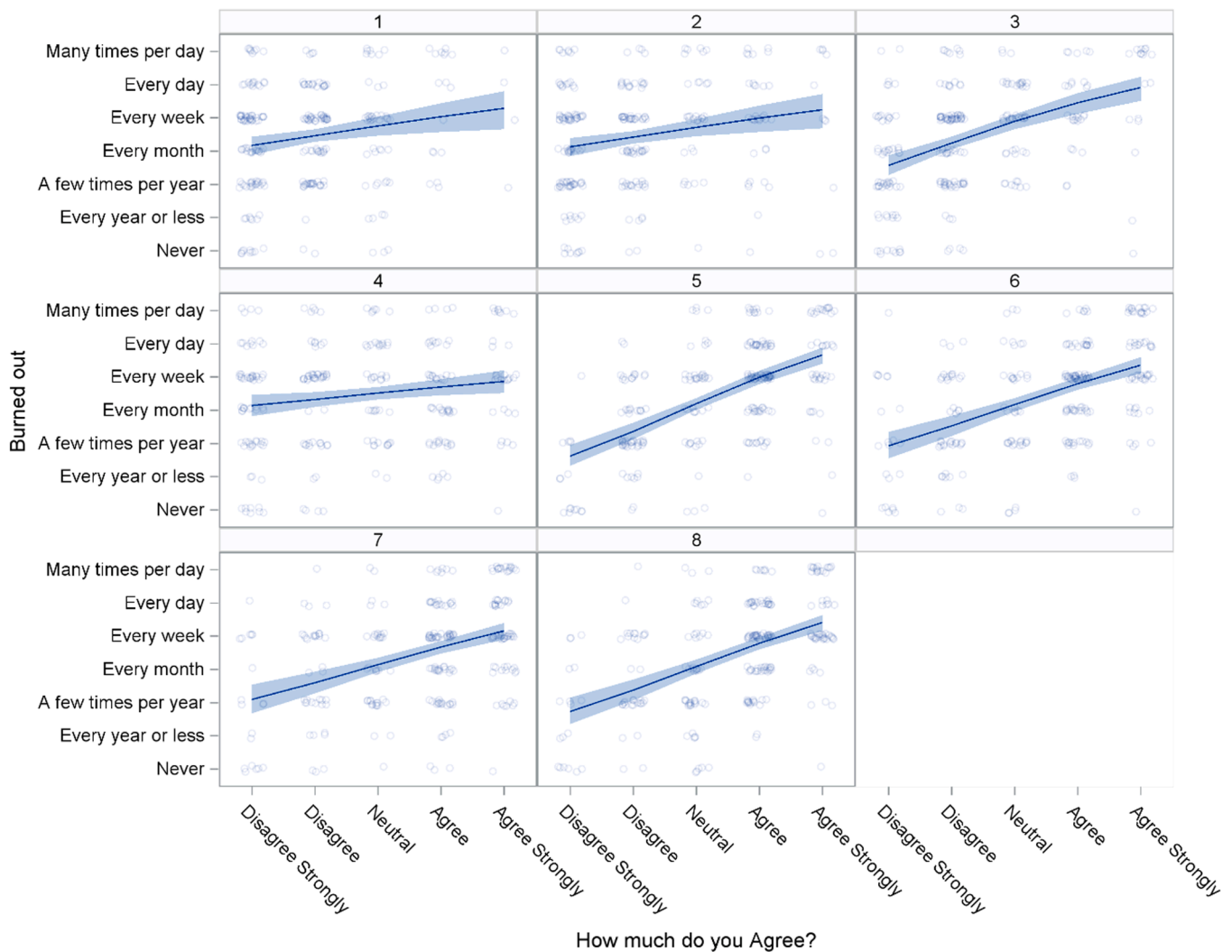


Fig. 3. Relationship between Self-reported burnout and Stressors During COVID-19. Note: Blue line is slope between burnout and stressors with 95% confidence band. Blue dots are observations. Y-axis is burnout Never (0) to Many times per day (6). X-axis is stressor question 1–8 and are as follows: 1. My current financial situation is a serious strain. 2. The prospect of losing my job or not finding a suitable job is a major source of stress in my life. 3. I wish I worked outside of medicine. 4. Providing, organizing, or paying for care for dependents is a major source of stress in my life. 5. Working in medicine is a major source of stress in my life. 6. Having to work more hours than I would like is a major source of stress in my life. 7. Having to practice faster than I would like because of a high volume of work is a major source of stress in my life. 8. Trying to balance the demands of my work with the time needed for my personal and family life is a major source of stress.

of burnout has been studied in other subspecialties of radiology. The prevalence of burnout has been reported to be 71.9% in interventional radiologists [13], 80.5% in musculoskeletal radiologists [16], and 85.2% in neuroradiologists [14]. The level of physician burnout observed here (i.e., self-reported emotional exhaustion occurring between monthly and weekly) is within the range reported in these other specialties. This range of burnout within radiology is higher than rates reported in other medical specialties [11]. The breadth and depth of these data collectively suggest there are factors uniquely inherent within the specialty of radiology that place radiologists at risk for burnout.

Following COVID-19, the majority of breast radiologists had frequent feelings of depersonalization (2.2 (95% CI [2.0–2.4]) or depersonalization occurring "several times a year" to "monthly") and emotional exhaustion (3.4 (95% CI [3.3, 3.6]) or emotional exhaustion occurring "a few times a month" to "weekly"). This is almost identical to their respective levels prior to the onset of COVID-19. Despite the frequent levels of emotional exhaustion and depersonalization following COVID-19, breast radiologists reported very frequent feelings of personal accomplishment (5.3 (95% CI [5.2, 5.3]) or feeling of personal accomplishment occurring "daily" to "many times of day"); this was

unchanged compared with before COVID-19. This consistency suggests that despite their frequent feelings of exhaustion and depersonalization, breast radiologists continue to feel inspired that they are making a difference. We postulate that direct patient care aspects of practicing breast radiology that include making a difference in a patient's life by early diagnosis of breast cancer or reassurance of benignancy provide fulfillment and may provide a protective factor for breast radiologists against burnout. Breast radiologists and radiology practice leaders should therefore strive to recognize, maintain and promote the positive contributions of breast radiologists while simultaneously addressing the factors that contribute to emotional exhaustion and depersonalization.

This study adds to our understanding of stress and burnout caused by the pandemic by also including burnout assessment items that can be directly compared to pre-pandemic data. Our study indicates that the level of burnout amongst practicing breast radiologists within the United States was not significantly different from before the onset of the COVID-19 pandemic. The prevalence of stressors after the onset of COVID-19 was lower in breast radiologists than before COVID-19. For example, the highest stress report by breast radiologists both before and during the pandemic was working faster than one would like. However,

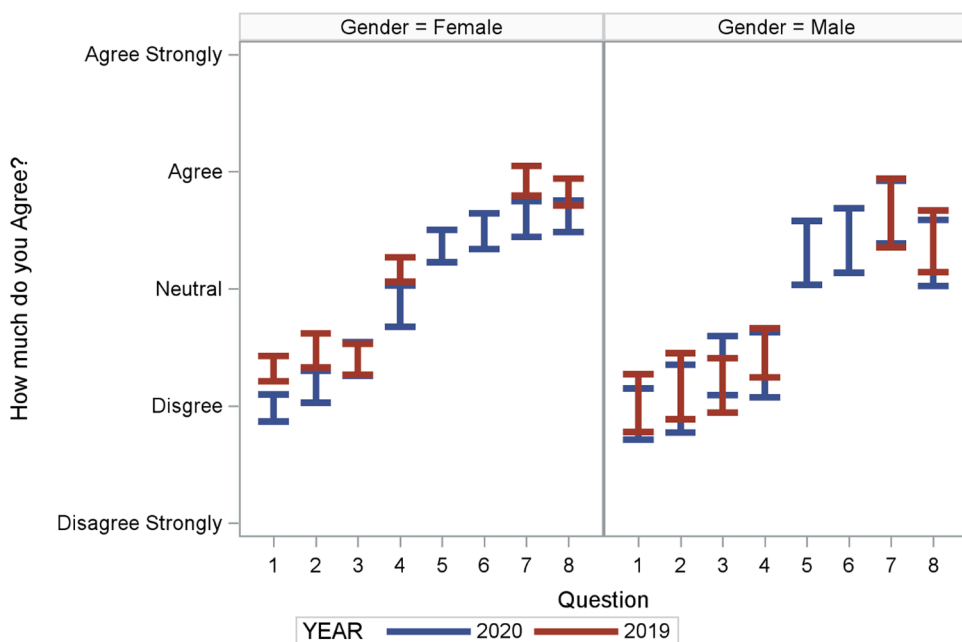


Fig. 4. Stressors for 2019 compared to 2020 by Gender. Note: Y-axis is Disagree Strongly (0) to Agree Strongly (6); Red is 2019, Blue is 2020 with 95% confidence intervals. X-axis is stressor question 1–8 and are as follows: 1. My current financial situation is a serious strain. 2. The prospect of losing my job or not finding a suitable job is a major source of stress in my life. 3. I wish I worked outside of medicine. 4. Providing, organizing, or paying for care for dependents is a major source of stress in my life. 5. Working in medicine is a major source of stress in my life 6. Having to work more hours than I would like is a major source of stress in my life 7. Having to practice faster than I would like because of a high volume of work is a major source of stress in my life 8. Trying to balance the demands of my work with the time needed for my personal and family life is a major source of stress.

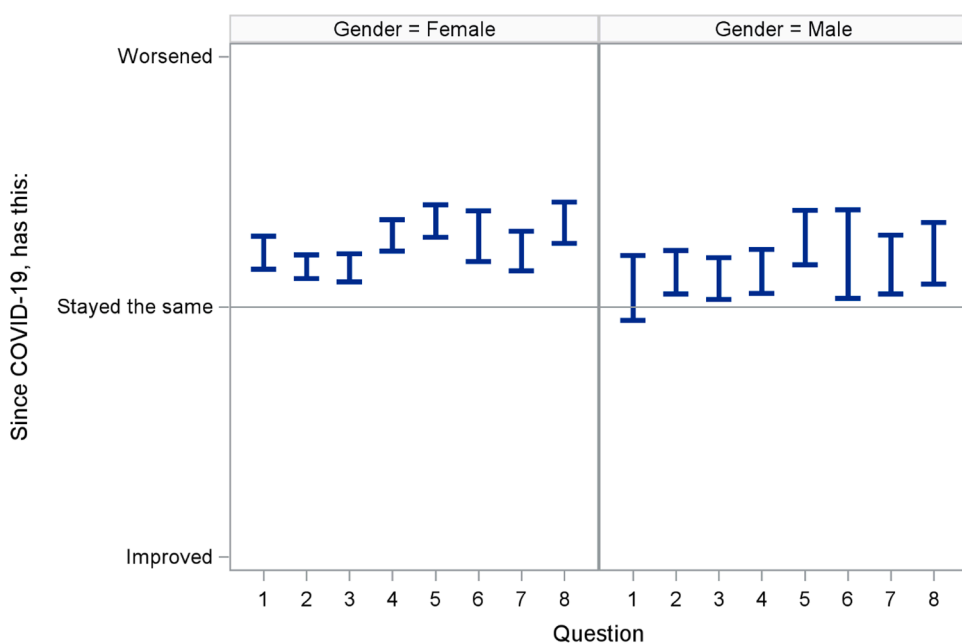


Fig. 5. Worsening Stressors During COVID-19 by Gender. Note: Y-axis is Improved (0) to Worsened (2) with 95% confidence intervals. X-axis is stressor question 1–8 and are as follows: 1. My current financial situation is a serious strain. 2. The prospect of losing my job or not finding a suitable job is a major source of stress in my life. 3. I wish I worked outside of medicine. 4. Providing, organizing, or paying for care for dependents is a major source of stress in my life. 5. Working in medicine is a major source of stress in my life 6. Having to work more hours than I would like is a major source of stress in my life 7. Having to practice faster than I would like because of a high volume of work is a major source of stress in my life 8. Trying to balance the demands of my work with the time needed for my personal and family life is a major source of stress. Please delete previous ordering.

during the pandemic there was a significant decrease in this stressor, presumably due to the decrease in mammography volume that occurred during the pandemic. However, self-perceived stress and burnout amongst breast radiologists however was higher post COVID-19 than before the onset of COVID-19. Higher self-perceived stressors following the onset of COVID-19 has been previously speculated in radiologists and specifically reported in breast radiologists [29]. Studies have similarly demonstrated elevated self-perceived stress of other healthcare workers during COVID [33,34].

Objective stress versus subjective stress has been studied with respect to allostatic load (AL). Allostatic load refers to the cumulative burden of chronic stress and life events, and involves the interaction of different physiological systems at varying degrees of activity [35]. Chronic stress has been consistently associated with adverse health outcomes [36–38]. Multiple studies suggest that this association arises from physiological

dysregulation, or allostatic load [39–41]. The physiological response facilitating short-term adaptation to stress has been postulated to become maladaptive if repeatedly activated by chronic stress. Allostatic overload ensues when environmental challenges exceed the individual ability to cope [35]. This repeated activation would then lead to progressive physiological dysregulation, ultimately resulting in disease and premature mortality. A large study showed that both self-perceived subjective stress and objective stress was associated with AL, but with a stronger association for objective stress [42]. The authors conclude the results suggested that measures of objective and self-perceived stress may have independent predictive validity of AL [42]. This independence of objective and self-perceived stress may explain the divergence of self-perceived and objective stress during the COVID-19 pandemic in this study.

Another possible explanation for the discrepancy between self-

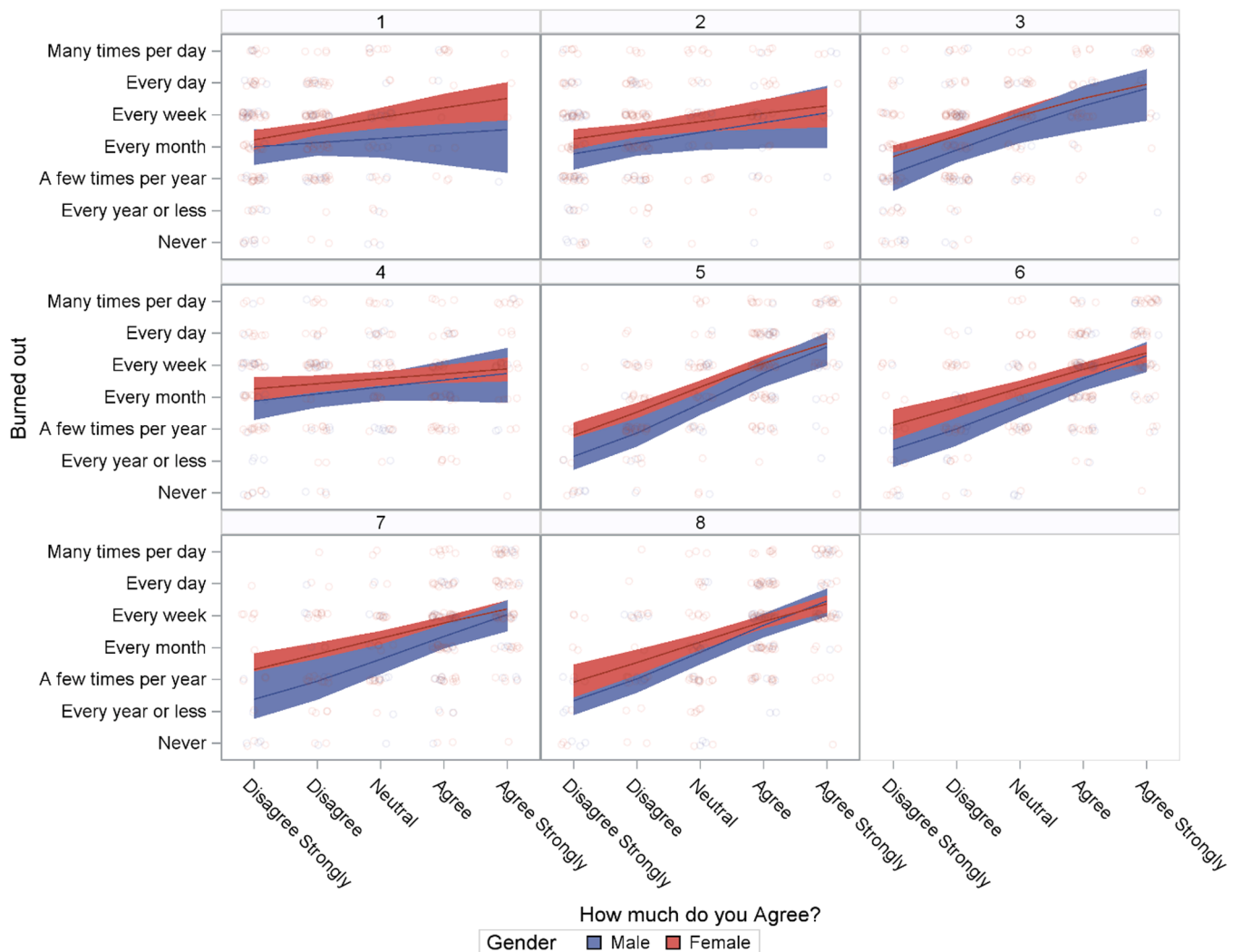


Fig. 6. Relationship between Self-reported burnout and Stressors During COVID-19 by Gender. Note: Line is slope between burnout and stressors with 95% confidence band. Red is those identifying as Female and Blue as Male. Blue dots are observations. Y-axis is burnout Never (0) to Many times per day (6). X-axis is stressor question 1–8 and are as follows: 1. My current financial situation is a serious strain. 2. The prospect of losing my job or not finding a suitable job is a major source of stress in my life. 3. I wish I worked outside of medicine. 4. Providing, organizing, or paying for care for dependents is a major source of stress in my life. 5. Working in medicine is a major source of stress in my life 6. Having to work more hours than I would like is a major source of stress in my life 7. Having to practice faster than I would like because of a high volume of work is a major source of stress in my life 8. Trying to balance the demands of my work with the time needed for my personal and family life is a major source of stress.

Table 4

In the last 30 days, I have seriously considered leaving my current position because (select all that apply):

	Count	%
Not considering	131	
Considering:	130	
Clinical workload too high	65	50.0
Cultural/interpersonal issues in the workplace	44	33.8
Diversity/equity/inclusion issues	18	13.8
Not paid enough	30	23.1
Work life balance	82	63.1
Other	32	24.6
Number of Issues		
1	51	39.2
2	34	26.2
3	33	25.4
4	8	6.2
5	3	2.3
All 6 issues	1	0.8

Table 5

In the last 30 days, I have seriously considered leaving my current position because (select all that apply):

	Female (n = 194)		Male (n = 64)	
	Count	%	Count	%
Work life balance	65	33.5%	17	26.6%
Clinical workload too high	49	25.3%	16	25.0%
Cultural/interpersonal issues in the workplace	32	16.5%	12	18.8%
Other	29	14.9%	3	4.7%
Not paid enough	23	11.9%	7	10.9%
Diversity/equity/inclusion issues	13	6.7%	5	7.8%

perceived increased stress without objective change in burnout measurements in the cohort is the cognitive bias of rosy retrospection. This refers to the human psychological tendency of judging the past disproportionately more positively than when judging the present [43,44]. Negative details about past events get forgotten while positive details

from past experiences remain in human memory. Current stressors therefore during the COVID-19 pandemic may therefore be disproportionately perceived by breast radiologists.

Yet another possible explanation is that the stress and perceived stress associated with being a breast radiologist may have been readjusted relative to the heightened stress and demands experienced by colleagues in other areas of medicine. Thus, breast radiologists may have been experiencing more stress during the pandemic than before, but their assessment of stress may be adjusted when they compare themselves to a new reference standard of stress in medicine, thus counterbalancing their reported stress to appear as if no change had occurred since the previous year. Relatedly, an additional consideration is that stress and factors of burnout did in fact change, though the ways in which stress and burnout were measured in this study do not (or cannot) reflect this change accurately (measurement error).

Nearly half of breast radiologists reported that they were considering leaving their current practice. The most common reasons for leaving were work life balance, followed by clinical workload, and interpersonal/cultural issues. Within the United States, the estimated cost for an organization to replace a physician is in the order of 1 million dollars [45]. Therefore, there is not only a moral case but a business case for radiology practice leaders to address radiologist burnout [12,46]. Historically, many organizations have addressed burnout by primarily on improving physician resilience [47]. However, the widespread epidemic of radiologist burnout in this and other studies supports the mounting data that radiology practice leaders need to not just focus on redesigning people but also redesigning process [12,48]. A previous study conducted by the American College of Radiology Commission on Human Resources found 77% of radiology leaders perceive radiologist burnout as a significant or very significant problem [49]. As radiology practice leaders are becoming increasingly accountable for addressing burnout in their radiologists [12], radiology leadership will need to learn from stakeholders opportunities for process improvement and implement creative solutions such as flexible schedules and hiring enough breast radiologists to spread out workload [50,51].

Our study had limitations. Only three burnout items (emotional exhaustion, depersonalization, and accomplishment) were used here for consistency and comparison with previous lines of research [16,52]. The results from abbreviated surveys in the study of physicians are generally considered to be equivalent to those from the full MBI along these dimensions [16]. Abbreviated surveys are utilized to increase physician participation and reduce survey fatigue. However, valid measurement of burnout can only be assessed using all items on the Maslach Burnout Inventory [32]. Thus, the high self-reported burnout observed here using only two items, and the high self-reported level of personal accomplishment as a protective factor observed here using only one item, are only indicative of possible burnout, as the full measures were not assessed. The purpose of the current research was to compare burnout items before and during the pandemic and thus were limited to only the items used previously. However, future research would ideally use the full scale for which these constructs were validated. In addition, because the surveys were anonymous, comparisons between before and during the pandemic are limited to group comparisons (instead of within-subjects comparisons). Moreover, a response bias may exist in that it is possible that more distressed radiologists responded to this survey given its subject matter; conversely, it is possible that less overwhelmed radiologists may have been more likely to respond.

In conclusion, we found no objective change in burnout among a cohort of breast radiologists before and during the COVID-19 pandemic, despite subjective reports that burnout was higher. This may be due to lower volumes of breast imaging work during the pandemic which counterbalanced pandemic related stressors. Now that imaging volume has re-bounded, further investigation is needed to continue to assess burnout longitudinally in this population.

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Ethical statement

This study was exempt from ongoing evaluation by the Rhode Island Hospital Institutional Review Board.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Jay Parikh, MD reports financial support was provided by National Institutes of Health.

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Author participation

All authors participated as follows:

- substantially contributed to the conception or design of the work
- writing and/or revision of the manuscript
- approved the final version of the manuscript
- are accountable for the manuscript's contents

Statements of access and integrity

The authors declare that they had full access to all of the data in this study and the authors takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

IRB approval

The institutional review board at Rhode Island Hospital approved this survey study and deemed it exempt from ongoing evaluation.

Manuscript type

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