A Review on Working Load and Burnout Toward Patient Safety in the Radiology Unit

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Abstract

Burnout is prevalent among radiology professionals and has been consistently linked to increased self-reported medical errors in various healthcare settings. However, direct evidence connecting burnout measured by the Maslach Burnout Inventory (MBI) to diagnostic errors in radiology image interpretation is lacking. This systematic review highlights an inferential gap due to the absence of studies simultaneously assessing MBI-measured burnout and objectively measured diagnostic errors in radiology. The strongest available evidence from prospective longitudinal studies in non-radiology populations demonstrates a bidirectional, dose-dependent association between burnout domains and perceived medical errors. Given the cognitive demands of radiological interpretation and the documented impact of burnout on cognitive functions, future research should directly evaluate this relationship within radiology professionals, incorporating relevant contextual moderators to inform targeted interventions aimed at improving patient safety.

Keywords: Burnout, Cognitive Function, Diagnostic Errors, Maslach Burnout Inventory, Medical Errors, Radiology, Patient Safety, Systematic Review

INTRODUCTION

The radiology unit is a central component of the diagnostic system in modern hospitals, where the volume of imaging requests continues to increase significantly over time [1,2]. This growth in the use of imaging technology is driven by various factors, including an aging population, a rising burden of disease, and limitations in available human resources [1]. These conditions place increasing pressure on radiology staff, with some departments even reporting a sevenfold rise in radiology workload [2]. The high dependency on imaging technology makes the workload of radiology staff extremely intensive, leading to rising cases of fatigue and burnout among radiologists [2,3]. Furthermore, the production of qualified radiology personnel has not kept pace with the ever-growing demand, resulting in delays in the provision of radiology reports [1,4]. High workloads have consistently been shown to trigger emotional exhaustion and burnout among healthcare workers, including radiographers and radiologists. In the context of radiology, burnout prevalence is reported to be very high, with 61% of radiologists reporting burnout symptoms, and reaching as much as 66–80% in certain subspecialties [1].

Burnout is defined as a syndrome of emotional exhaustion, depersonalization, and decreased work performance caused by prolonged workplace stress, impacting not only individuals but also the overall productivity and quality of organizational services [4,5]. Excessive workload is assumed as the main trigger for emotional exhaustion, eventually leading to burnout, while systemic factors such as understaffing, irregular working hours, and poor organizational management further exacerbate the situation [6]. Burnout is not merely an individual issue, but a reflection of systemic failure in hospital organizational management, where misalignment between personal and organizational values has been shown to inversely correlate with radiology staff burnout levels, and interventions that are needed must focus on the system level, not just on individual resilience. Declining cognitive function caused by burnout poses a real threat to the accuracy of radiological image interpretation and technical procedure execution. Burnout has consistently been shown to impair three main cognitive functions (executive function, attention, and memory), all of which are critical foundations in the process of interpreting medical images [1].

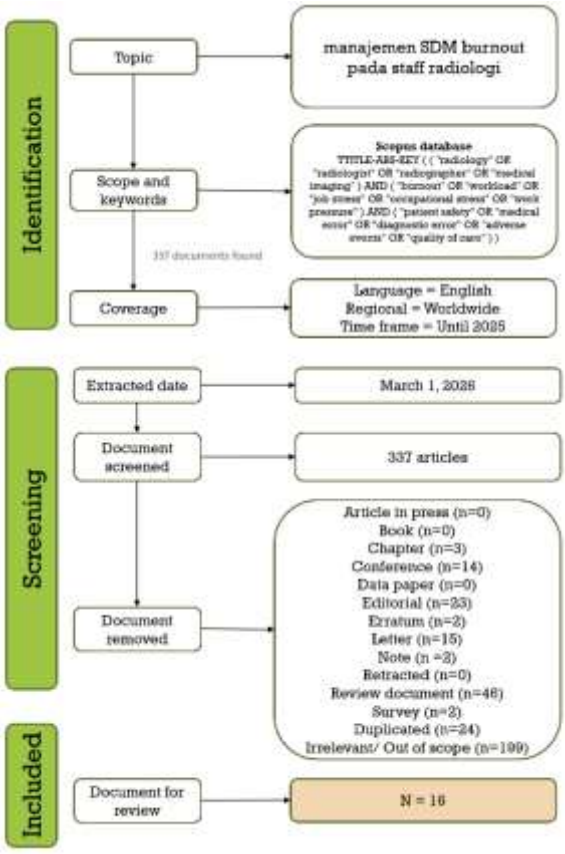
Furthermore, visuospatial abilities (crucial for radiology staff in manipulating medical instruments, hand-eye coordination, and perceiving spatial anatomy) also deteriorate significantly as a result of burnout, directly endangering patient safety [2]. In radiological practice, interpretation errors are categorized into perceptual and cognitive errors, where mental condition and burnout have been shown to significantly worsen diagnostic accuracy [3]. Errors in the radiology unit have a fatal domino effect, as flawed radiology reports will affect the referring physician's clinical decisions and result in improper patient management [4]. This is exacerbated by findings that high cognitive load due to excessive work pressure directly increases the risk of medical errors and burnout simultaneously [5]. Studies of radiographers in tertiary government hospitals also confirm a significant relationship between burnout levels and the quality of patient care, including patient safety dimensions.

Burnout among radiology personnel is not merely a matter of individual well-being, but a systemic threat to the overall quality and safety of diagnostic services. Although current literature has extensively explored the relationship between workload, burnout, and patient safety in radiology units, the inconsistency of findings among primary studies has created a significant research gap. The high heterogeneity, both in methodology and

operational context across different hospitals, makes it difficult to draw a single, universal conclusion using a quantitative approach. Therefore, a Systematic Literature Review (SLR) with a narrative synthesis approach is the most appropriate instrument to deeply analyze emerging patterns and the contextual factors underlying these divergent findings. Through this systematic review, research is expected to comprehensively map the dynamics between HR management and clinical risk, thus providing a foundation for hospital management to formulate more adaptive evidence-based management policies to improve patient safety standards in radiology departments. The high degree of variability and the contradictory nature of research findings on the impact of workload and burnout on patient safety in radiology units present major challenges for hospital decision-makers when designing effective interventions. This extreme heterogeneity indicates that the relationship is not linear, but highly influenced by managerial context, modality variations, and diverse organizational backgrounds. Without systematic efforts to map and narratively synthesize these various findings, understanding of the mechanisms by which work pressure affects clinical risk will remain fragmented. As a consequence, risk mitigation strategies for patient safety in radiology departments risk losing crucial context and failing to address the root problems at the operational level.

METHODS

The Systematic Literature Review (SLR) method employed in this study involves a structured and comprehensive approach to identify, screen, and synthesize relevant literature on the impact of workload and burnout on patient safety in radiology units. The process begins with a defined search strategy using specific keywords applied to the Scopus database, followed by screening studies according to predetermined inclusion and exclusion criteria, focusing on healthcare professionals in radiology, measurement of burnout and workload, and patient safety outcomes. Data extraction includes tabulating key study characteristics such as author, year, study design, burnout measurement tools, and main findings related to patient safety. The synthesis is narrative, involving grouping studies by characteristics, identifying patterns in results, and qualitatively analyzing heterogeneity to explain divergent findings. Quality assessment of included studies is performed using the Joanna Briggs Institute (JBI) critical appraisal tools to evaluate risk of bias. This method enables a comprehensive and contextualized understanding of the complex relationships among workload, burnout, and patient safety by integrating diverse evidence and addressing



methodological and contextual variability across studies.

Figure 1. Prisma Protocol

RESULT

The final studies are divided into three main categories: (1) studies examining burnout and medical errors in the general healthcare population, (2) studies examining burnout or well-being specifically among radiology professionals but without measuring diagnostic errors, and (3) studies investigating diagnostic errors or performance in the field of radiology without assessing burnout using the MBI. Based on the review results, only two studies involved radiology professionals and assessed some form of burnout or well-being, but neither measured diagnostic interpretation errors[7,8]. Anikina *et al.* (2024) investigated diagnostic errors by radiologists using eye tracking but did not assess burnout[9]. Other studies analyzing the relationship between burnout and errors with robust methodology were conducted among internal medicine residents[10,11], junior doctors from all specialties[12], or mixed physician populations[13,14].

Table 1. Burnout and Medical Errors in the General Healthcare Service Population

Study	Burnout Measure	Error Measure	Key Effect Estimate	Statistical Significance	Direction
[13]	MBI-GS (exhaustion, cynicism, professional efficacy)	Self-reported medical errors at 1-year follow-up	High burnout: RR = 1.19 (95% CI: 1.05–1.35); High exhaustion: RR = 1.31 (95% CI: 1.10–1.55); High cynicism: RR = 1.31 (95% CI: 1.13–1.53)	p = 0.008 overall; p < 0.05 for exhaustion and cynicism domains	Positive
[10]	MBI (quarterly)	Self-perceived major medical errors	Depersonalization OR = 1.09 (95% CI: 1.05–1.12); Emotional exhaustion OR = 1.06 (95% CI: 1.04–1.08); Lower personal accomplishment OR = 0.94 (95% CI: 0.92–0.97)	p < .001 for all three domains	Positive for depersonalization and emotional exhaustion; inverse for personal accomplishment
[11]	MBI (every 6 months)	Self-perceived medical errors (quarterly)	Increased burnout in all domains is associated with increased odds of subsequent error; errors also predicted subsequent worsening of burnout	p = .001 (depersonalization), p < .001 (emotional exhaustion), p = .02 (personal accomplishment)	Bidirectional positive association
[15]	MBI full-scale and single-item measures	Self-perceived major medical errors	Single-item emotional exhaustion and depersonalization measures showed strong associations consistent with full MBI; all p ≤ 0.008	p ≤ 0.008	Positive

Study	Burnout Measure	Error Measure	Key Effect Estimate	Statistical Significance	Direction
[12]	MBI-HSS	Self-reported errors ("played on their mind")	66.4% of burned-out junior doctors reported errors vs. 47.8% of non-burned-out; emotional exhaustion increased over time	$p = 0.03$ at time 2	Positive
[14]	MBI-HSS	Self-reported perceived medical errors	Burnout scores predicted perceived errors (ß = 0.009, $p < 0.001$)	$p < 0.001$	Positive
[16]	Stanford Professional Fulfillment Index (not MBI)	Self-reported errors in the past 3 months	Coaching reduced burnout (difference-in-difference: −0.37, 95% CI: −0.64 to −0.09); coachees had 2.18 times greater odds of reporting no error (not significant)	Burnout reduction is significant; error reduction is not significant	Positive trend (reduced burnout associated with fewer errors, though the error difference was not significant)

Across all general health studies using the MBI, there is consistent evidence of a statistically significant positive association between higher burnout scores and increased self-reported medical errors. The prospective longitudinal design of West *et al.* is highly informative, as it shows that burnout predicts the occurrence of future errors, and that those errors, in turn, predict subsequent worsening of burnout, indicating a reciprocal cycle[11]. In the largest of these studies (n = 380), each one-unit increase in depersonalization was associated with a 9% higher likelihood of later experiencing a perceived major error (OR = 1.09), and each one-unit increase in emotional exhaustion was associated with a 6% higher likelihood (OR = 1.06)[10]. Trinh *et al.* (2024) reinforced these findings in a cohort group in Japan, finding that healthcare workers with an overall high level of burnout had a 19% higher risk of experiencing medical errors over the course of a year (RR = 1.19)[13]. The magnitude of this effect is indeed relatively modest in absolute terms, but it is consistent across various studies and statistically robust. An important finding from Parris *et al.* (2025) is that an intervention (coaching) which successfully reduced burnout was associated with a non-significant trend towards a decrease in self-reported errors (OR for not reporting errors: 2.18), indicating that this relationship may be modifiable, even though the study was not designed to detect a reduction in error rates[16].

Table 2. Burnout and Well-being Among Radiology Professionals

Study	Population	Burnout/Well-being Finding	Relationship to Errors
[7]	Diagnostic radiology residents	Baseline MBI-HSS showed no frequent burnout symptoms; significant decrease in resilience among women ($p = .002$); higher resilience correlated with less emotional exhaustion ($r = -0.56$) and depersonalization ($r = -0.59$)	Not assessed
[8]	Radiologists (46%), radiographers (35%)	Low individual and organizational resilience; significant decline in resilience (mean decrease 7.46, $p = 0.018$) and mindfulness (mean decrease 1.7, $p < 0.001$) at follow-up	No significant effect on self-reported quality and safety
[17]	Radiologists and radiotherapists (n = 654)	High occupational stress: job strain OR = 4.89 (95% CI: 2.51–9.55) and effort-reward imbalance OR = 4.66 (95% CI: 2.17–10.02) for metabolic syndrome	Not assessed
[18]	Radiographers (n = 12)	Ergonomic redesign reduced general fatigue by 22.38% ($p < 0.05$)	Not assessed (examination speed improved 12.50%)

Among studies that specifically address radiology, Perry *et al.* (2021) found that radiology residents begin their training without frequent symptoms of burnout; however, women experienced a significant reduction in resilience, and high resilience was highly negatively correlated with emotional exhaustion and depersonalization[7]. Gransjøen *et al.* (2023) documented initially low resilience and mindfulness among Norwegian radiology professionals, with a further significant decline at follow-up, although this did not impact measurable differences in self-reported quality and safety[8]. Magnavita *et al.* (2014) showed that radiologists experience high levels of work-related stress as measured by the Karasek and Siegrist models, in which stressed radiologists were almost five times more likely to develop metabolic syndrome[17]. These findings confirm that burnout and work-related stress are commonly encountered among radiology professionals, but none of these studies measured diagnostic interpretation errors.

Anikina *et al.* (2024) used eye-tracking technology on four radiologists analyzing 1,000 chest radiographs and achieved an ROC AUC of 0.7755 in predicting diagnostic errors using gaze pattern-based features and recurrent neural networks[9]. This study shows that diagnostic errors in radiological interpretation can be predicted from behavioral measurements, but it did not assess burnout as a contributing factor[9]. Dawes *et al.* (2004) demonstrated that radiology training significantly improved image interpretation performance among medical students (correct answers increased from 8% to 43%, $p < 0.001$), highlighting experience as a key determinant of diagnostic accuracy, although burnout was not measured[19]. Contextual Factors and Moderation Several contextual factors identified in various studies may influence the relationship between burnout and errors, and are also relevant to the radiology setting.

Table 3. Diagnostic Errors in Radiology Without Assessment of Burnout

Factor Category	Specific Factors Identified	Source
Workload pressures	Time pressure is positively associated with burnout (ß = 0.167, p < 0.001), increased workload from rising diagnostic imaging use, and high demand scores among radiologists	8,14,17
Individual factors	Resilience is protective against burnout (r = −0.56 for emotional exhaustion), fatigue, and depression, independently associated with errors, and younger age is associated with higher burnout (ß = −0.125, p < 0.001)	7,10,14
Work environment	COVID-19 pandemic and digital system transitions increased stress, ergonomic mismatch contributed to fatigue, clinical work hours show dose-effect with burnout	8,18,20
Organizational factors	Unsatisfactory rewards for radiologists, coaching improved burnout and professional fulfillment, lack of structured well-being programs	8,16,17

Time pressure and increasing case volume are highly relevant determining factors in radiology, where image interpretation requires sustained cognitive vigilance. Magnavita *et al.* (2014) found that high work demands coupled with excessive commitment are widespread among radiologists [17], while Gransjøen *et al.* (2023) noted that the COVID-19 pandemic and the simultaneous rollout of digital systems exacerbated stress from workload [8]. Resilience appears to be protective: Perry *et al.* (2021) reported a moderate to strong negative correlation between resilience and both emotional exhaustion and depersonalization among radiology residents, indicating that individual differences in resilience may moderate the potential pathway from burnout to performance decline[7].

Table 4. Journal Quality Assessment

Study	Appropriate Statistics	Inclusion Criteria Clear	Subjects/Setting Described	Objective Measurement	Valid Exposure Measure	Confounders Identified	Confounders Addressed	Valid Outcome Measure
[13]	Yes	No	Unclear	Yes	Yes	Yes	Yes	Yes
[7]	Yes	Yes	Yes	Yes	No	Yes	No	Yes
[14]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear
[8]	Yes	No	Yes	No	Unclear	Yes	Yes	Yes
[12]	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes
[10]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
[11]	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
[15]	Yes	Unclear	Yes	Yes	Yes	Yes	Unclear	Yes
[18]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
[17]	Yes	Yes	Yes	No	Yes	Yes	Yes	Unclear
[20]	Yes	Unclear	Yes	No	Yes	Yes	No	Yes
[19]	Yes	No	Yes	Yes	Yes	Unclear	Unclear	Yes
[16]	Yes	Unclear	Yes	Yes/No	Unclear	Unclear	Unclear	Yes
[21]	Yes	Unclear	Yes	Yes	Unclear	Yes	Yes	Yes
[22]	Yes	Yes	Yes	Yes	Yes	Yes/No	Yes	Yes
[9]	Unclear	No	Unclear	Yes	Yes	No	No	Yes

DISCUSSION

The main question of whether burnout measured by the MBI among radiology staff is significantly associated with diagnostic errors cannot be answered directly based on the available evidence. No studies identified in this review simultaneously measured MBI burnout in radiology professionals and counted the number of diagnostic interpretation errors. Burnout has been found among radiology personnel. Perry *et al.* (2021) showed that radiology residents experience changes related to burnout during their training, with women showing a significant decrease in resilience [7]. Gransjøen *et al.* (2023) documented low and declining levels of resilience and mindfulness among Norwegian radiology staff [8], and Magnavita *et al.* (2014) indicated extremely high work stress among Italian radiologists using a validated stress model [17]. Burnout measured by the MBI has been consistently supported as being associated with increased self-reported medical errors across various healthcare populations. Six studies using the MBI found a statistically significant positive association between burnout and self-reported errors [10-15]. The prospective cohort studies conducted by West *et al.* (2006, 2009) are methodologically the strongest, showing a temporal sequence with burnout occurring before error reports [10,11]. The review results indicate consistent associations between burnout and errors. However, this should be interpreted with specific caveats. First, all error measurements in burnout studies rely on self-reporting [10-14], which introduces the possibility of reporting bias and may not capture the specific cognitive failures underlying missed diagnoses or false positive interpretations in imaging. Second, none of the burnout-error studies involved radiology-specific populations; participants were general healthcare professionals[13], internal medicine residents [10,11], or physicians from various specialties [14]. The nature of diagnostic errors in radiology (which involves perceptual and cognitive processing of visual information under time pressure) may differ mechanistically from medication errors, procedural errors, or other error types more commonly found in the studied populations. The pathway from burnout to diagnostic errors in radiology is quite plausible. Emotional exhaustion reduces available cognitive resources for sustained attention during image interpretation, while depersonalization may undermine the patient-centered approach necessary for thorough interpretations. West *et al.* (2009) found that exhaustion and stress were independently associated with the occurrence of errors, and these effects remained when modeled together [10]. Anikina *et al.* (2024) showed that gaze patterns could predict diagnostic errors with fairly high accuracy (AUC = 0.7755) [9], indicating that attentional processes (which are known to be disrupted by burnout) are central to diagnostic accuracy in radiology. Tamayo Vasco *et al.* (2025) attempted to link burnout to executive function deficits using cognitive testing but did not find a significant correlation, possibly due to the small sample size (n = 36) and a predominance of moderate rather than high burnout levels in their sample [22]. The apparent difference between Gransjøen *et al.* (2023), who did not find an association between decreased resilience/mindfulness

and self-reported quality and safety [8], and the broader literature suggesting a burnout-error link may be explained by the extremely small follow-up sample size (n = 13), the use of self-reported quality instead of objective error measurement [8], as well as the possibility that radiology staff have compensatory mechanisms (e.g., double reading, structured reporting) that help buffer the effects of individual burnout in practice. Although indirect evidence consistently supports a positive association between MBI-measured burnout and self-reported medical errors in various healthcare settings, and burnout has been documented as common among radiology personnel, the specific relationship with diagnostic errors in radiology image interpretation remains an inferential gap. The strongest available evidence comes from prospective longitudinal studies in non-radiology populations that show a bidirectional and dose-dependent association between burnout domains and perceived errors [10,11].

CONCLUSION

Indirect evidence shows a consistent positive link between MBI-measured burnout and self-reported medical errors across healthcare settings, with burnout common among radiology staff. However, the direct relationship between burnout and diagnostic errors in radiology remains unproven. The strongest evidence comes from prospective longitudinal studies in non-radiology populations demonstrating a bidirectional, dose-dependent association between burnout and perceived errors.

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