Duazary / Vol. 22 - 2025 / e6465
DOI: https://doi.org/10.21676/2389783X.6465

Review article

Burnout and work stress in radiology technicians: A narrative review

Agotamiento psicológico y estrés laboral en técnicos en radiología: una revisión narrativa

Gina Marcela Mahecha-Naranjo[1] * Leandro Efraín Álvarez-Alucema[2] * Yelis Campo-Torregrosa[3]

Rubén Darío López-Sepúlveda[4] * Darío Javier García-Martínez[5] * Martha Cecilia Tuirán-Tinoco[6]

To cite this article: Mahecha-Naranjo G, Álvarez-Alucema L, Campo-Torregrosa Y, López-Sepúlveda D, García-Martínez D, Tuirán-Tinoco M. Burnout and work stress in radiology technicians: A narrative review. Duazary. 2025;22:e6465.

Received on February 24, 2025
Accepted on April 09, 2025
Posted online on April 25, 2025

ABSTRACT

This text addresses the issue of work-related stress in radiology technicians within the context of the rapid changes occurring in the health sector. Technological advancements, the increasing demand for services, and shifts in work organization have created an increasingly demanding work environment for healthcare professionals, including radiology technicians. Psychosocial factors prevalent in this work environment, such as excessive workloads, precarious working conditions, and a lack of recognition, are identified as the primary triggers of stress and burnout in these professionals. Prolonged exposure to these conditions can lead to a wide range of health problems, both physical and psychological, affecting the workers' quality of life and, consequently, the quality of medical care. This review demonstrates that work-related stress is a significant problem for radiology technicians, with consequences for individuals and organizations. It calls for further research and the implementation of measures to improve working conditions and promote the well-being of these professionals.

Keywords: Radiology; Work stress; Burnout; Quality of life; Work environment; Review.

RESUMEN

El texto aborda la problemática del estrés laboral en técnicos de radiología, enmarcado en los cambios acelerados que experimenta el sector salud. Los avances tecnológicos, la creciente demanda de servicios y los cambios en la organización del trabajo han generado un entorno laboral cada vez más exigente para los profesionales de la salud, incluso para los técnicos en radiología. Los factores psicosociales presentes en el entorno laboral, como las cargas de trabajo excesivas, las condiciones laborales precarias y la falta de reconocimiento, se identifican como principales desencadenantes de estrés y agotamiento psicológico en estos profesionales. La exposición prolongada a estas condiciones puede generar una amplia gama de problemas de salud físicos y emocionales, los que afectan la calidad de vida de los trabajadores y la calidad de la atención médica. La revisión evidencia que el estrés laboral es un problema significativo para los técnicos en radiología, con consecuencias para los individuos y las organizaciones. Se hace un llamado a la investigación y a la implementación de medidas para mejorar las condiciones laborales y promover el bienestar de estos profesionales.

Palabras clave: radiología; estrés laboral; agotamiento psicológico; calidad de vida; entorno laboral; revisión.

1. Universidad Nacional Abierta y A Distancia. Sincelejo, Colombia. Correo: gina.mahecha@unda.edu.co - https://orcid.org/0000-0002-5672-4513
2. Universidad del Magdalena. Santa Marta, Colombia. Correo: lalvarez@unimagdalena.edu.co - https://orcid.org/0000-0002-5900-2647
3. Universidad Nacional Abierta y A Distancia. Santa Marta, Colombia. Correo: yelis.campo@unad.edu.co - https://orcid.org/0000-0002-5972-1350
4. Universidad del Magdalena. Santa Marta, Colombia. Correo: rlopez@unimagdalena.edu.co - https://orcid.org/0000-0001-5413-9356
5. Universidad Nacional Abierta y A Distancia. Sincelejo, Colombia. Correo: dario.garcia@unad.edu.co - https://orcid.org/0000-0003-0182-2842
6. Universidad Nacional Abierta y A Distancia. Cartagena, Colombia. Correo: martha.tuiran@unad.edu.co - https://orcid.org/0000-0002-6925-8494

INTRODUCTION

Contemporary health systems are undergoing an accelerated transformation driven by demographic, social, and epidemiological changes and unprecedented technological advances.[1] This evolving dynamic generates a series of challenges for health professionals, who face greater complexity in their functions, an increasing demand for services, and the need for constant updating of their skills. Likewise, modifications are observed in the organization of work, including longer working hours, job insecurity, and a negative impact on the psychosocial health of workers.[2]

In context, there is a growing interest in the study of psychosocial factors present in work scenarios related to work organization, such as position type, task performance, and environment, all of which influence workers' health.[3] Psychosocial factors can positively or negatively affect work activity and individuals' quality of life. Positive factors promote personal growth, while negative factors constitute a health risk, manifesting as work stress and potentially causing psychological, physical, or social harm.[1]

Studies conducted in various work sectors, including healthcare, have shown that chronic work stress is associated with an increased risk of developing a wide range of health problems, such as cardiovascular disease, musculoskeletal disorders, depression, substance abuse, psychiatric disorders, burnout syndrome, and a lower subjective perception of health.[4-6]

The healthcare sector has continuously changed in economic, socio-political, and technical-scientific spheres. Furthermore, the trend toward organizational competitiveness can hinder the development of social support among colleagues. Compounding this are the economic situation in Latin America and the underestimation of professions, factors that influence professionals' behavior, adaptation, and flexibility. Specifically, radiology services have implemented new management forms focused on maximizing production and profits, adopting advanced technologies, and maintaining salary policies that do not correspond to their workers' qualifications, particularly radiology technicians.[7] This context can lead to the emergence of occupational diseases, work stress, and even burnout syndrome.[8] Exposure to psychosocial risks affects workers' health and hurts organizations, resulting in lower job satisfaction, increased absenteeism, workplace accidents, and more significant staff turnover.[9] These consequences may, in turn, compromise the quality of services offered.

The hospital environment's dynamics impose high work stress levels on radiology technicians. Most care in the healthcare setting is geared towards patient care, making interaction with patients and their families critical.[10,11] Several studies indicate a strong connection between work stress and responsibility towards patients. The relationship between healthcare professionals and patients entails profound emotional experiences, some very rewarding and others emotionally exhausting.[12,13] Although interaction with patients is not usually as prolonged for radiology technicians as for other professionals, tensions that can sometimes be overwhelming and lead to burnout syndrome are still generated.[11] Therefore, the purpose of this study is to review the existing evidence in the scientific literature on the working conditions of radiology technicians, with a particular focus on burnout and work stress.

FUNCTION AND EMPLOYMENT STATUS

Radiology technicians base their role on medical imaging through various technologies, from X-rays to MRI. Their work is essential in the accurate diagnosis of diseases and the design of treatments. Using tools such as ultrasounds, computed tomography scans, and radioactive materials, these professionals contribute significantly to medical care, representing between 4% and 7% of health personnel in

countries such as the United States, Canada, and Mexico.[14-19] In addition to recruitment challenges, many Asian countries face difficulties retaining health professionals, such as attending physicians and radiologists. Global competition for medical talent and factors such as job dissatisfaction, burnout, and understaffing contribute to this problem. To ensure quality and sustainable healthcare, healthcare institutions must develop effective strategies to retain their employees.[17,18] For this reason, Matalon *et al*.[20] propose the creation of more attractive work environments that respond to the needs of professionals and promote their professional development. Research is also needed to identify and address occupational stressors that affect health worker satisfaction, particularly those engaged in medical imaging.

BURNOUT

The World Health Organization (WHO) has defined burnout as a chronic syndrome derived from prolonged and unmanaged work stress.[21] This phenomenon has spread alarmingly among health professionals, with prevalence rates exceeding 50%.[22,23] In fact, radiologists report significantly higher burnout levels than doctors in other specialties.[22,24] According to Maslach *et al*.,[25,26] burnout manifests itself through three interrelated dimensions: emotional exhaustion, characterized by feelings of fatigue, exhaustion, and emotional depletion; depersonalization, which is expressed as a cynical and distant attitude towards work and patients; and reduced personal accomplishment, which is reflected in feelings of incompetence and dissatisfaction with professional achievements.

Burnout in the healthcare sector not only compromises healthcare quality by increasing medical errors and malpractice lawsuits,[27,28] it also decreases patient satisfaction and negatively impacts service delivery.[29-32] The personal consequences of burnout can be devastating, including substance abuse and suicide.[33] While remote work, adopted as a temporary measure during the pandemic, has demonstrated multiple benefits,30 it has also introduced new challenges that can exacerbate burnout, such as a lack of social interaction and distractions from the home environment.[34] Burnout is a complex problem that arises from a combination of factors, including excessive workloads, inefficient processes, administrative obligations, work-life imbalance, lack of participation in decision-making, and an unfavorable organizational culture.[35]

The areas of radiology are not exempt from the growing problem of professional burnout. Recent studies have shown that residents and established radiologists experience high work stress and burnout levels.[36,37] In fact, it is estimated that between 54% and 72% of diagnostic and interventional radiologists have symptoms compatible with burnout syndrome.[38] A significant increase in workload exacerbates this situation, as well as the imposition of increasingly tight deadlines for the delivery of reports and the multiplication of clinical and administrative professional responsibilities.36 Staff shortages further exacerbate this problem, contributing to a widespread sense of work overload.[39]

The current configuration of the medical work environment, characterized by a high concentration of professionals in large institutions such as academic medical centers, health maintenance organizations, and large hospital groups, represents an additional risk factor for the development of burnout syndrome among radiologists.[40] This predominantly hierarchical and bureaucratic organizational model is often associated with ineffective and outdated management practices and intense pressure for profitability and cost containment. These working conditions, marked by limited professional autonomy and an organizational culture focused on short-term results, can generate a feeling of dehumanization and alienation among health professionals, contributing to burnout.[40,41]

While remote work has been explored as a possible solution to reduce stress in radiology, its implementation in clinical practice presents significant challenges, especially in the case of interventional radiology. The procedural nature of this specialty, which requires direct interaction with the patient and the use of specialized equipment, limits the possibility of performing these tasks remotely.[42] In addition, the lack of clarity regarding the role of interventional radiologists within large health systems, often perceived as technicians rather than doctors, can lead to additional stress and negatively affect their professional performance.[43]

WORK STRESS

Stress, a typical response to various life situations, manifests in a particular way in the workplace, generating negative consequences for workers and organizations. If prolonged, this physiological and psychological response can deteriorate employees' physical and mental health, affecting their quality of life and, consequently, their work performance. Work-related stress can translate into decreased productivity, increased absenteeism, and higher staff turnover, generating significant economic losses for companies.[44]

According to the WHO, work stress arises as a response to work demands that exceed an individual's capabilities.[45] This definition is complemented by the contributions of other authors, such as Tobal *et al*.,[46] describe stress as a set of complex reactions to adverse work situations. Together, these perspectives allow us to understand work stress as a multifactorial phenomenon involving physical, emotional, cognitive, and behavioral aspects that can manifest itself chronically or acutely, generating negative consequences for both the individual and the organization.[44]

According to Miranda,[47] work stress is not homogeneous but varies depending on each worker's characteristics. Thus, the author distinguishes between acute work-related stress, which manifests as an intense and temporary response to demanding situations, and chronic work-related stress, which persists over time and can generate long-term consequences for the worker's health and well-being. This classification highlights the importance of considering the individual response to stressful situations and the need to adopt personalized coping strategies.

In today's context, the accuracy and efficiency of healthcare depend heavily on the precise interpretation of medical images, a critical task that falls to radiologists.[48] The increasing complexity of cases and rapid technological advances have significantly increased the workload of these professionals, who must also contend with increasing bureaucracy and documentation.[49] Radiology resident physicians, in particular, are at a crucial stage of their training, characterized by an intense workload, high academic expectations, and relatively low remuneration. This situation underscores the need to ensure the physical and psychological well-being of future radiologists to guarantee quality training and sustainable professional practice.[50]

Several studies have shown a direct relationship between work stress and the deterioration of professional performance.[51-53] Prolonged exposure to stressful situations can decrease motivation, concentration, and the ability to make effective decisions, negatively affecting the quality of work performed. For radiologists, stress can influence the accuracy of diagnoses and consequently compromise patient safety.[54] Likewise, radiology technicians experience high levels of stress that affect not only their physical and mental health but also their job satisfaction.[55,56] However, despite the existing evidence on the impact of stress on other healthcare professionals, further research is still required to fully understand the consequences of stress on the specific performance of radiologists.

BURNOUT AND RISK FACTORS

Burnout syndrome in radiologists has increased significantly, evidenced by the increase in its prevalence.[57] Before the COVID-19 pandemic, approximately one-third of radiologists were experiencing burnout.[58] During the pandemic, this figure increased to half of the professionals. In the United States, burnout in radiologists rose from 36% in 2013 to 46% in 2020.[59,60] These data suggest that the pandemic exacerbated an already existing problem in this population.

The findings of various investigations suggest several notable trends in identifying factors contributing to such occupational risks: first, workload, work shifts, interruptions, and patient-related factors appeared to play a more prominent role in contributing to occupational risks compared to factors specific to the technician or organizational structure.[57-59]

Some research, such as Luceño-Moreno *et al*.[61] and Torrente *et al*.[62] have associated emotional exhaustion and depersonalization with symptoms of anxiety in women and depression in men; however, in the study, Oprisan *et al*.,[57] no correlation was found with gender or other sociodemographic and labor factors; nor were constant risk or protection factors identified before and after the pandemic. For its part, Chen *et al*.[63] noted that working as an abdomen and pelvis radiologist could be a protective factor, although they make it clear that more research is required to confirm this relationship.

Professional burnout in radiologists is a complex phenomenon, and it is not easy to associate with specific characteristics since their relationship can vary over time. Lack of motivation could be related to an approach focused on diagnostic imaging rather than comprehensive patient care.[57] The European Society of Radiology proposes a shift towards a value-based practice, where the radiologist has a more active role.[64]

In addition to the stress factors previously mentioned, Alshamrani *et al*.[65] found that a rigid leadership style and disparities in employee treatment increased 68% of occupational risks; understaffing and lack of adequate radiation protection devices, mentioned by more than half of respondents and high workloads, long working hours, and physically demanding tasks. Also, it was found that frequent interaction with infectious or emotionally unstable patients and fear of making mistakes, such as dangers related to patient interaction and safety, are stress causes.

Moreover, 84% of the study group suggested improvements in service organization, and proposals to improve mood included reducing workload and the number of on-call shifts and establishing explicit daily activities for each professional.[65]

The above reveals the need for multifaceted solutions. In the Medscape Survey,[66] radiology ranked 18th in professional burnout, with 36% of affectation, which rose to 46% in 2020, placing it sixth. This frequency is particularly worrisome since radiology is considered a specialty of high intellectual demand and the third in time and effort for diagnosis, after emergency medicine and internal medicine.[67]

PRACTICAL ISSUES

Work-related stress is a significant challenge for radiology professionals. Despite the importance of their role in healthcare, radiologists face several stressors that negatively impact their well-being and professional performance. The combination of high workloads, tight deadlines, increasing administrative responsibilities, and an often-demanding organizational culture contributes to the development of burnout syndrome.[68]

The consequences of work-related stress in radiology are multifaceted and range from the deterioration of professionals' physical and mental health to the decrease in the quality of medical care. Emotional exhaustion, depersonalization, and reduced personal fulfillment are common symptoms of burnout in this professional group. In addition, work-related stress can negatively affect the accuracy of diagnoses and decision-making, putting patient safety at risk.[69]

Comprehensive strategies must be implemented to promote the well-being of radiologists and improve working conditions in the medical imaging sector.[70] These strategies include optimizing work processes, reducing administrative burdens, implementing stress management training programs, promoting a healthier organizational culture, and strengthening social support systems.[69]

The consequences of this stress and burnout are far-reaching, impacting not only the well-being of these professionals – potentially leading to decreased job satisfaction, increased errors, and even severe personal issues – but also the quality of patient care through reduced accuracy in diagnoses and decreased service delivery. While remote work presents potential benefits, its applicability in specialties like interventional radiology is limited.[65]

Addressing this critical issue requires multifaceted solutions, including optimizing work processes, reducing administrative burdens, implementing stress management programs, fostering supportive organizational cultures, and promoting a shift toward value-based practice that recognizes the integral role of radiologists in comprehensive patient care. Further research is also crucial to fully understand the specific stressors affecting radiology professionals and to develop targeted interventions that ensure a sustainable and high-quality healthcare system.[70]

CONCLUSIONS

The vital role of radiology professionals is increasingly challenged by significant work-related stress and burnout. This phenomenon, characterized by emotional exhaustion, depersonalization, and reduced personal accomplishment, is alarmingly prevalent among radiologists and radiology technicians, exceeding rates in other medical specialties. It is exacerbated by high workloads, tight deadlines, administrative burdens, staffing shortages, and demanding organizational cultures.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest.

AUTHOR CONTRIBUTION

GMN participated in the conceptualization, bibliographic review, writing, and final approval of the manuscript.
LAA drafted and approved the manuscript.
YCT participated in the bibliographic review and final approval of the manuscript.

DLP participated in database search and final approval of the manuscript.
DGM participated in database search, writing, and final approval of the manuscript.
MTT participated in database search, writing, and final approval of the manuscript.

REFERENCES

1. Acevedo GE, Sánchez J, Farías MA, Fernández AR. Riesgos psicosociales en el equipo de salud de hospitales públicos de la Provincia de Córdoba, Argentina [Psychosocial risks in the health team of public hospitals in the Province of Cordoba, Argentina]. Cienc Trab. 2013;15:140-7. https://doi.org/10.4067/S0718-24492013000300006
2. Gil Monte PR. Riesgos psicosociales en el trabajo y salud ocupacional [Psychosocial risks at work and occupational health]. Rev Peru Med Exp Salud Publica. 2012; 29:237-41. https://doi.org/10.1590/S1726-46342012000200012
3. Chirico F, Afolabi AA, Ilesanmi OS, Nucera G, Ferrari G, Sacco A, et al. Prevalence, risk factors and prevention of burnout syndrome among healthcare workers: An umbrella review of systematic reviews and meta-analyses. J Health Soc Sci. 2021;6:465-91.
4. Romeral Hernández J. Gestión de la seguridad y salud laboral, y mejora de las condiciones de trabajo: el modelo español [Occupational health and safety management, and improvement of working conditions: The Spanish model]. Bol Mex Der Comp. 2012;45:1325-39. https://doi.org/10.22201/iij.24484873e.2012.135.4786
5. Garay-Cabrera GR, Velásquez-Rondón S. Gestión de la prevención de riesgos en el trabajo y el estado de salud autopercibida [Management of occupational risk prevention and self-perceived health status]. Gac Cientif. 2020;6:41-53. https://doi.org/10.46794/gacien.6.1.721
6. Galbán KKF. Los riesgos psicosociales en el trabajo: un reto colectivo en el desarrollo laboral cubano [Psychosocial risks at work: A collective challenge in Cuban labor development]. Lex Social. 2018;8:174-205.
7. Baptista MJ, Tavares EP. Fontes de pressão no emprego e seu potencial na qualidade vida de fisioterapeutas [Sources of professional pressure and their pontential impact on physiotherapist´s quality of life]. Rev Lusofona Cienc Tecnol Saude. 2009;6:186-95.
8. Christofoletti G, Pinto SM, Vieira AN. Análise das condi-ções físico-mentais de funcionários do setor de pedia-tria do Hospital das Clínicas de Goiânia [Analysis of the physical and mental conditions of employees in the pediatrics sector of the Hospital das Clínicas de Goiânia]. Movimenta. 2008;1:7-10 .
9. Palma A, Gerber MM, Ansoleaga E. Riesgos psicosociales laborales, características organizacionales y salud mental: el rol mediador de la violencia laboral [Occupational psychosocial risks, organizational characteristics, and mental health: the mediating role of workplace violence]. Psykhe. 2022;31:1-18. https://doi.org/10.7764/psykhe.2019.22383
10. Ramírez MR, Otero P, Blanco V, Ontaneda MP, Díaz O, Vázquez FL. Prevalence and correlates of burnout in health professionals in Ecuador. Compr Psychiatry. 2018;82:73-83. https://doi.org/10.1016/j.comppsych.2017.11.011
11. Da Silva CAV, Pereira JMR. Risco de burnout nos técnicos de radiologia das unidades de saúde do Porto [Risk of burnout in radiology technicians in care units of Porto]. Saude Tecnol. 2020;(23):38-50.
12. Suñer-Soler R, Grau-Martín A, Flichtentrei D, Prats M, Braga F, Font-Mayolas S, et al. The consequences of burnout syndrome among healthcare professionals in Spain and Spanish-speaking Latin American countries. Burnout Res. 2014;1:82-9. https://doi.org/10.1016/j.burn.2014.07.004

13. Albaladejo R, Villanueva R, Ortega P, Astasio P, Calle ME, Domínguez V. Síndrome de burnout en el personal de enfermería de un hospital de Madrid. Rev Esp Salud Publica [Burnout syndrome in nursing staff at a hospital in Madrid]. 2004;78:505-16. https://doi.org/10.1590/S1135-57272004000400008

14. Magnavita N, Fileni A, Bergamaschi A. Satisfaction at work among radiologists. Radiol Med. 2009;114:1330-44. https://doi.org/10.1007/s11547-009-0461-z

15. Park JY, Kang GB, Kim GH, Ahn JS, Hong SW, Lee JS, et al. The appropriateness of wage and job satisfaction of radiological technologists. J Radiol Sci Technol. 2018;41:617-26. https://doi.org/10.17946/JRST.2018.41.6.617

16. Alamri S, Faizo N, Alelyani M, Alghamdi A, Altwerqi S, Almalki N, et al. Are radiology technologists satisfied with their work? A cross-sectional study from taif hospitals. Open J Radiol. 2020;10:45. https://doi.org/10.4236/ojrad.2020.102006

17. Akyurt N. Job satisfaction and perceived stress among radiology technicians: a questionnaire survey in relation to sociodemographic and occupational risk factors. Int Arch Occup Environ Health. 2021;94:1617-26. https://doi.org/10.1007/s00420-021-01667-1

18. Akyurt N. Knowledge, practice and emotional status related to COVID-19 pandemic among radiology technicians working at pandemic hospitals. Eur J Radiol. 2021;134:109431. https://doi.org/10.1016/j.ejrad.2020.109431

19. Eslick GD, Raj VV. Occupational stress amongst radiographers: Does working in private or public practice make a difference? Radiography. 2002;8:47-53. https://doi.org/10.1053/radi.2001.0356

20. Matalon SA, Guenette JP, Smith SE, Uyeda JW, Chua AS, Gaviola GC, Durfee SM. Factors influencing choice of radiology and relationship to resident job satisfaction. Curr Probl Diagn Radiol. 2019;48:333-41. https://doi.org/10.1067/j.cpradiol.2018.03.008

21. World Health Organization. For mortality and morbidity statistics. Geneva: World Health Organization; 2018.

22. Shanafelt TD, Hasan O, Dyrbye LN, Sinsky C, Satele D, Sloan J, et al. Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014. Mayo Clin Proc. 2015;90:1600-1613. https://doi.org/10.1016/j.mayocp.2015.08.023

23. Rotenstein LS, Torre M, Ramos MA, Rosales RC, Guille C, Sen S, et al. Prevalence of burnout among physicians: A systematic review. JAMA. 2018;320:1131-50. https://doi.org/10.1001/jama.2018.12777

24. Gies CS, Gupte A, Dudley JC, Healey MJ, Boland GW, Khorasani R. Self-reported burnout: Comparison of radiologists to nonradiologist peers at a large academic medical center. Acad Radiol. 2022;29:277-83. https://doi.org/10.1016/j.acra.2020.10.013

25. Maslach C, Jackson SE. The measurement of experienced burnout. J Organ Behav Educ. 1981;2:99-113. ttps://doi.org/10.1002/job.4030020205

26. Maslach C, Schaufeli WB, Leiter MP. Job burnout. Annu Rev Psychol. 2001;52:397-422. https://doi.org/10.1146/annurev.psych.52.1.397

27. Recht MP. Work from home in academic radiology departments: Advantages, disadvantages and strategies for the future. Acad Radiol. 2023;30:585-9. https://doi.org/10.1016/j.acra.2022.11.019

28. Dunnick NR. Burnout at home. Acad Radiol. 2021;28:593-4. https://doi.org/10.1016/j.acra.2021.02.010

29. West CP, Dyrbye LN, Shanafelt TD. Physician burnout: Contributors, consequences and solutions. J Intern Med. 2018;283:516-29. https://doi.org/10.1111/joim.12752

30. Rawson JV, Smetherman D, Rubin E. Short-term strategies for augmenting the national radiologist workforce. Am J Roentgenol. 2024;222:e2430920. https://doi.org/10.2214/AJR.24.30920

31. Fawzy NA, Tahir MJ, Saeed A, Ghosheh MJ, Alsheikh T, Ahmed A, et al. Incidence and factors associated with burnout in radiologists: A systematic review. Eur J Radiol Open. 2023;11:100530. https://doi.org/10.1016/j.ejro.2023.100530

32. Rawson JV, Davis MA. Change management: A framework for adaptation of the change management model. Trans Healthc Syst Eng. 2023;13:198-204. https://doi.org/10.1080/24725579.2023.2201959

33. Ismail M, Hanna TN, Davis MA, Rubin E, De Quesada IM, Miles RC, et al. The remote academic radiologist: AJR Expert Panel Narrative Review. Am J Roentgenol. 2024;222:e2329601. https://doi.org/10.2214/AJR.23.29601

34. Le RT, Sifrig B, Chesire D, Hernandez M, Kee-Sampson J, Matteo J, et al. Comparative analysis of radiology trainee burnout using the Maslach Burnout Inventory and Oldenburg Burnout Inventory. Acad Radiol. 2023;30:991-7. https://doi.org/10.1016/j.acra.2022.08.016

35. Oliveira A, Gowda V, Jordan SG. It takes a village: A multimodal approach to addressing radiologist burnout. Curr Probl Diagn Radiol. 2022;51:289-92. https://doi.org/10.1067/j.cpradiol.2021.11.003

36. Dunnick NR. Short term gain or long term success? Acad Radiol. 2024;31:1229-30. https://doi.org/10.1016/j.acra.2024.02.033

37. Dyrbye LN, West CP, Satele D, Boone S, Tan L, Sloan J, et al. Burnout among US medical students, residents, and early career physicians relative to the general US population. Acad Med. 2014;89:443-51. https://doi.org/10.1097/ACM.0000000000000134

38. Ganeshan D, Wei W, Yang W. Burnout in chairs of academic radiology departments in the United States. Acad Radiol. 2019;26:1378-84. https://doi.org/10.1016/j.acra.2018.12.006

39. Canon CL, Chick JFB, De Quesada I, Gunderman RB, Hoven N et al. Physician burnout in radiology: Perspectives from the field. Am J Roentgenol. 2022;218:370-4. https://doi.org/10.2214/AJR.21.26756

40. Nicola R, McNeeley MF, Bhargava P. Burnout in radiology. Curr Probl Diagn Radiol. 2015;44:389-90. https://doi.org/10.1067/j.cpradiol.2015.04.007

41. Restauri N, Flug JA, Mcarthur TA. A picture of burnout: Case studies and solutions toward improving radiologists' well-being. Curr Probl Diagn Radiol. 2017;46:365-8. https://doi.org/10.1067/j.cpradiol.2016.12.006

42. Kwee RM, Kwee TC. A new working paradigm for radiologists in the post-COVID-19 world. J Am Coll Radiol. 2022;19:324-6. https://doi.org/10.1016/j.jacr.2021.06.015

43. Bailey CR, Bailey AM, McKenney AS, Weiss CR. Understanding and appreciating burnout in radiologists. Radiographics. 2022;42:137-9. https://doi.org/10.1148/rg.220037

44. Portocarrera-Pezo PT, Pinheiro-Rodriguez KDJ. Estrés laboral y características socio-laborales en el personal de salud que trabaja en el servicio COVID-19 del Hospital Regional de Loreto. [Workplace stress and socio-labor characteristics in healthcare personnel working in the COVID-19 service of the Loreto Regional Hospital, 2021] San Juan: Universidad Científica del Peru; 2022.

45. Organización Mundial de la Salud. La organización del trabajo y el estrés: documento de orientación de la OMS [Work organization and stress: A WHO guidance document]. Ginebra: Organización Mundial de la Salud; 2004.

46. Tobal JJ, Cano-Vindel A. Estrés y trabajo [Stress and work]. Sevilla: Instituto Andaluz de Administración Pública; 2005.

47. Miranda B. Estrés laboral en el personal que labora en el servicio de bioanálisis del Hospital Dr. Domingo Luciani [Workplace stress in personnel working in the bioanalysis service of Dr. Domingo Luciani Hospital]. Caracas: Universidad Católica Andrés Bello; 2008.

48. Luo S, Zhang Y, Wang P, Yang Z, Zheng J, Wang Z, et al. The moderating role of resilience in the association between workload and depressive symptoms among radiology residents in China: Results from a nationwide cross-sectional study. Eur Radiol. 2024:34:695-704. https://doi.org/10.1007/s00330-023-10021-7

49. Brady A, Brink J, Slavotinek J. Radiology and value-based health care. JAMA. 2020;324:1286-7. https://doi.org/10.1001/jama.2020.14930

50. Xiao YT, Wang YT. Standardised residency training: Students' concerns. Lancet. 2017;389:905. https://doi.org/10.1016/S0140-6736(17)30596-2

51. Foy T, Dwyer RJ, Nafarrete R, Hammoud MSS, Rockett P. Managing job performance, social support and work-life conflict to reduce workplace stress. Int J Prod Perf Manag. 2019;68:1018-41. https://doi.org/10.1108/IJPPM-03-2017-0061

52. An J, Liu Y, Sun Y, Liu C. Impact of work–family conflict, job stress and job satisfaction on seafarer performance. Environ Res Public Health. 2020;17:2191. https://doi.org/10.3390/ijerph17072191

53. Li L, Ai H, Gao L, Zhou H, Liu X, Zhang Z, et al. Moderating effects of coping on work stress and job performance for nurses in tertiary hospitals: A cross-sectional survey in China. Health Serv Res. 2017;17:1-8. https://doi.org/10.1186/s12913-017-2348-3

54. Plessas A, Nasser M, Hanoch Y, O'Brien T, Bernardes-Delgado M, Moles D. Impact of time pressure on dentists' diagnostic performance. J Dent. 2019;82:38-44. https://doi.org/10.1016/j.jdent.2019.01.011

55. Sipos D, Kunstár O, Kovács A, Petőné-Csima M. Burnout among oncologists, nurses, and radiographers working in oncology patient care during the COVID-19 pandemic. Radiography. 2023;29:503-8. https://doi.org/10.1016/j.radi.2023.02.008

56. Ji J, He B, Gong S, Sheng M, Ruan X. Network analysis of occupational stress and job satisfaction among radiologists. Front Public Health. 2024;12:1411688. https://doi.org/10.3389/fpubh.2024.1411688

57. Oprisan A, Baettig-Arriagada E, Baeza-Delgado C, Martí-Bonmatí L. Prevalencia y factores de desgaste profesional en radiólogos durante la pandemia COVID-19 [Prevalence and factors of professional burnout in radiologists during the COVID-19 pandemic]. Radiologia. 2022;64:119-27.

58. Oprisan A, Baettig-Arriagada E, Baeza-Delgado C, Martí-Bonmatí L. Prevalencia del síndrome de desgaste en radiólogos españoles [Prevalence of burnout syndrome in Spanish radiologists]. Radiologia. 2023;65:307-14.

59. Chetlen AL, Chan TL, Ballard DH, Frigini LA, Hildebrand A, Kim S, et al. Addressing burnout in radiologists. Acad Radiol. 2019;26:526-33.

60. Martin K, Koval ML. Medscape radiologist lifestyle happiness & burnout report 2021; 2021.

61. Luceño-Moreno L, Talavera-Velasco B, García-Albuerne Y, Martín-García J. symptoms of posttraumatic stress, anxiety, depression levels of resilience and burnout in Spanish health personnel during the COVID-19 pandemic. Int J Environ Res Public Health. 2020;17:5114.

62. Torrente M, Sousa PA, Sánchez-Ramos A, Pimentao J, Royuela A, Franco F, et al. To burnout or not to burnout: A cross-sectional study in healthcare professionals in Spain during COVID-19 pandemic. BMJ Open. 2021;11:e044945. https://doi.org/10.1136/bmjopen-2020-044945

63. Chen H, Cohen P, Chen S. How big is a big odds ratio? Interpreting the magnitudes of odds ratios in epidemiological studies. Commun Stat-Simul C. 2010;39:860-4.

64. European Society of Radiology (ESR). ESR concept paper on value-based radiology. Insights Imaging. 2017;8:447-54.

65. Alshamrani KM, Alzahrani DA, Alghamdi YS, Aljohani LM, Al Nufaiei ZF. Saudi radiology technologists' perception of occupational hazards from a personal and social lens. Risk Manag Healthc Policy. 2024;17:2609-22.

66. Kane L. Medscape national physician burnout & suicide report 2020: The generational divide. Medscape; 2021.

67. Harry E, Sinsky C, Dyrbye LN, Makowski MS, Trockel M, Tutty M, et al. Physician task load and the risk of burnout among us physicians in a national survey. Joint Comm J Qual Patient Saf. 2021;47:76-85.

68. West CP, Dyrbye LN, Shanafelt TD. Physician burnout: contributors, consequences and solutions. J Intern Med. 2018;283:516-29.

69. Moro C, Grani C, Triberti S, Vegni E, Pravettoni G. Burnout syndrome in radiologists: A systematic review. Eur Radiol. 2016;26:3749-58.

70. Tawfik DS, Sexton JB, Adair KC, Profit J, Williams NM, Satele DV, et al. Physician burnout, well-being, and work unit safety climate in health care organizations: A cross-sectional study. Mayo Clin Proc. 2019;94:32-43.