# Assessment of the Role of Experience in Shaping Sustainability Perceptions within Radiography

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## Abstract

**Introduction:** Perceptions of environmental sustainability among radiographers can potentially be influenced by individual experiences and educational backgrounds. This study aims to investigate the perceptions and practices of radiographers regarding sustainability initiatives, emphasizing the significance of understanding their diverse experiences and backgrounds.

**Methods:** This was an online survey involving 104 radiographers from various regions worldwide to evaluate their training related to global warming, their perceptions of sustainability, current practices, and the barriers they face in implementing sustainability practices..

**Results:** Participants' knowledge regarding sustainability was significantly influenced by their social networks, including friends and family ($\chi^2$=12.505, p=0.004). Notable correlations were observed between years' of experience and the belief in pollution's contribution to climate change ($\chi^2$=8.096,p=0.038), as well as the perception of human activities as the primary cause of climate change ($\chi^2$=22.68,p=0.011). Furthermore, involvement in environmental protection initiatives ($\chi^2$=19.268, p=0.033) and the perception of local climate impacts ($\chi^2$=22.478, p=0.012) were positively correlated with experience. In the field of radiography, the adoption of energy-efficient practices ($\chi^2$=10.482, p=0.011) and the recycling of imaging waste ($\chi^2$=25.778, p=0.004) were significantly associated with levels of experience. Lastly, the barrier identified as "Lack of Authority to make change" also exhibited a significant relationship with years of experience ($\chi^2$=9.449, p=0.022).

**Conclusion:** This study indicates that staff experiences play a significant factor influencing sustainability engagement among radiographers. Barriers identified include financial constraints, insufficient leadership, safety concerns, and inadequate training.

**Impact on practice:** The current study highlights the essential requirement for customized strategies based on radiographers' experiences to improve sustainable practices in

radiography. It acknowledges the impact of organizational barriers and suggests that progress toward a more sustainable future can be achieved through individual empowerment and collaboration within the healthcare sector.

**Keywords:** Radiography, Experience, Sustainability Practices, Climate Change, Global Warming.

**Introduction**

The global volume of radiological procedures has experienced a significant increase, accompanied by a notable rise in the frequency of these procedures per capita in comparison to earlier evaluations[1, 2].

In light of these increases, there is a pressing need to prioritize sustainability and green radiography initiatives within the healthcare sector. By promoting evidence-based referral practices, investing in alternative imaging modalities with a lower environmental impact, and implementing strategies to reduce unnecessary tests, healthcare providers can mitigate the adverse effects of overutilization while advancing environmental stewardship. In addition, fostering interdisciplinary collaborations and raising awareness among healthcare professionals about the environmental impact of their practices can drive meaningful change toward a more sustainable healthcare system[5-7]. Furthermore, it is imperative to conduct a comprehensive investigation of current practices to determine whether experience can indeed promote higher levels of sustainability practice. Experience has shown that it greatly affects the knowledge and skills of radiography professionals in various subfields of the discipline[8, 9]. This necessitates a thorough examination of the factors that influence decision-making processes within medical imaging departments, particularly the role of experience in shaping attitudes and behaviors toward sustainability initiatives[10-12].

Radiographers' experience not only influences the quality of diagnostic imaging but also significantly affects the efficiency and effectiveness of healthcare systems globally. Experienced radiographers, in addition to their expertise in radiography practice, possess a deep understanding of the healthcare system and the specific challenges faced in their field. Experienced radiographers are knowledgeable about the equipment and technology used in medical imaging departments and can identify opportunities for improvement. With their extensive knowledge and refined skills, experienced radiographers adeptly navigate the complexities of daily practice, ensuring accurate diagnoses, minimizing radiation exposure, reducing the frequency of image retakes, and improving workflow to enhance patient care. Furthermore, experienced radiographers frequently assume leadership positions within their departments, promoting evidence-based practices and serving as valuable resources for their less experienced colleagues[13-16].

While the influence of expertise on diagnostic outcomes has been well documented[17, 18], there remains a gap in understanding how this experience aligns with the broader objectives of

sustainability and the pressing challenges posed by climate change within the field of radiography. As the global healthcare sector confronts the urgent necessity to mitigate its environmental impact while promoting sustainable practices, despite the growing recognition of sustainability as a critical concern[19, 20]. However, the specific influence of radiographers' experiences on the perception and practices of sustainability within radiology remains unexplored.

This research aims to investigate the influence of radiographers' experience on sustainability within the domain of diagnostic imaging practices. The primary objective is to provide insights that can inform policies, practices, and educational methodologies in the field of radiography by elucidating the intricate relationships among expertise, sustainability, and resilience to climate change. By illuminating the complex interplay between the experience of radiographers and the pressing necessity for sustainable practices, this research establishes a foundation for informed decision-making and transformative initiatives within the field of radiology.

## Methods

### Ethical approval

The Ethics Committee of Gulf Medical University (IRBeCOHSeFAC-110-2024) granted approval for the study. Participants were required to provide informed consent after being comprehensively briefed on the objectives of the research. To maintain confidentiality, participants were not asked to disclose their identities. Data collection occurred from January 10, 2024, to March 20, 2024. The research team had exclusive access to the securely stored and anonymized data throughout the duration of the study.

### Participants

The study involved radiographers from various countries who possessed recent clinical experience, either currently or within the preceding five years. Participation in the survey was voluntary, and only individuals who met specific eligibility criteria were invited to participate. Eligible participants were required to be certified radiographers holding a valid license, actively engaged or having been engaged in a clinical radiology setting within the past five years, and proficient in English, which was the primary language of the survey. Exclusion criteria encompassed radiographers who were not currently practicing or had not practiced within the past five years, those lacking valid certification, and individuals not proficient in English. The questionnaire was disseminated through multiple channels, including various social media platforms, applications, and email distribution.

Recruitment employed non-probability sampling methods, specifically convenience and snowball sampling techniques. The survey was disseminated through professional radiography associations and social media platforms, such as LinkedIn and Facebook groups. In the snowball sampling approach, initial participants were encouraged to share the survey link with eligible colleagues. The questionnaire was administered on a secure online platform, and participants were required to provide informed consent prior to commencing the survey. Response and completion rates were calculated and reported in accordance with the CHERRIES guidelines for online surveys [21].

Questionnaire Development

A Google Forms (Google Inc., Mountain View, CA) online questionnaire was developed following a comprehensive review of the pertinent literature regarding the attitudes and behaviors of various professions toward environmental sustainability in alternative sectors. The design of the questionnaire adhered to the CHERRIES checklist to ensure methodological rigor and compliance with established guidelines[21]. Furthermore, elements from previous questionnaires assessing sustainability attitudes among healthcare professionals were integrated, thereby enhancing the content validity and relevance of the instrument[22-25].

The survey comprised 36 closed-ended questions, employing various formats, including multiple-choice questions with and without text entry options, as well as drop-down questions. Special attention was devoted to ensuring the clarity and neutrality of the wording in the questions to mitigate any potential bias in the responses. Furthermore, appropriate professional terminology and language specific to the study population were employed.

The questionnaire was systematically organized into five distinct domains: demographics; training received on global warming and climate change; perceptions regarding sustainability practices; barriers to sustainability; and radiography practices. Prior to its official deployment, the questionnaire underwent a pilot phase involving three experienced radiographers from the research team. During this phase, the format, layout, and logical coherence of the questions were evaluated. Subsequent modifications were implemented based on feedback collected from a preliminary pilot study conducted with five local radiographers, prior to the online distribution of the questionnaire for data collection. Notably, respondents were afforded the opportunity to review and amend their answers through a review step, which presented a summary of their responses to ensure accuracy and completeness. This feature was enhanced by JavaScript functionality, which required the completion of all necessary fields before submission and prompted participants to address any omissions post-submission, thereby safeguarding data integrity. Additionally, the survey system incorporated an IP address check to identify potential duplicate entries from the same user.

Reliability

The reliability of the questionnaire was evaluated utilizing the test-retest method [26]. Three participants were selected to complete the questionnaire on two separate occasions, with a two-week interval between the administrations. The resulting Pearson correlation coefficient was calculated to be 0.82, indicating strong internal consistency (≥ 0.8). It is noteworthy that the participants involved in this reliability assessment were distinct from those included in the primary study sample, thereby ensuring the integrity of the evaluation process.

Data Analysis

Data analysis was performed using the IBM SPSS software package version 20.0 (IBM Corp., Armonk, NY). Categorical data were presented as frequencies and percentages. The association between categorical variables was examined using the Chi-square test. When more than 20% of the cells had an expected count of less than 5, either the Fisher's exact test or the Monte Carlo correction test was used. Descriptive statistics, including range (minimum and maximum values), mean, standard deviation, and median, were used to summarize quantitative data. The significance level for the obtained results was established at 5%.

**Results:**

Demographic data, including variables such as gender, age, academic degree, years of experience, workplace, and area of practice, are summarized and presented in **Table 1.**

**Table 1: Distribution of the cases studied according to demographic data (n = 104)**

| | No. (%) |
|---|---|
| **Gender** | |
| Male | 51 (49.0%) |
| Female | 53 (51.0%) |
| **Age (years)** | |
| Mean ± SD. | 27.71 ± 8.81 |
| Median (Min. – Max.) | 25 (19-65) |
| **Academic degree** | |
| Diploma | 5 (4.8%) |
| BSc | 84 (80.8%) |
| MSc | 10 (9.6%) |
| PhD | 5 (4.8%) |
| **Years of experience** | |
| 1 - 3 | 55 (52.9%) |
| 4 - 6 | 18 (17.3%) |
| 7 - 9 | 7 (6.7%) |
| >9 | 24 (23.1%) |
| Mean ± SD. | 6.43±8.13 |
| Median (Min. – Max.) | 3 (1 – 42) |
| **Workplace** | |
| Private Hospital | 32 (30.8%) |
| Public/government hospitals | 22 (21.2%) |
| University Hospital | 50 (48.1%) |
| **Subspecialty** | |
| CT | 18 (17.3%) |
| MRI | 22 (21.2%) |
| General Radiography | 42 (40.4%) |
| Others | 22 (20.1%) |

SD: **standard deviation.**

## Background and training sustainability

In the analysis of the relationship between years' of experience and sustainability background, a significant finding emerged concerning the sources of information regarding sustainability and recycling. Specifically, participants indicated that friends and family exerted a significant influence on their knowledge ($\chi^2 = 12.505$, $p = 0.004$) (**Table 2**).

**Table 2: Relationship between years' of experience, background, and training sustainability (n = 104)**

| Sustainability background and training | Total (n = 104) | Years of experience 1 - 3 (n = 55) | 4 - 6 (n = 18) | 7 - 9 (n = 7) | >9 (n = 24) | $\chi^2$ | $^{MC}p$ |
|---|---|---|---|---|---|---|---|
| **I attend advanced training courses about sustainability.** | | | | | | | |
| No | 56 (53.8%) | 28 (50.9%) | 10 (55.6%) | 3 (42.9%) | 15 (62.5%) | 1.338 | 0.749 |
| Yes | 48 (46.2%) | 27 (49.1%) | 8 (44.4%) | 4 (57.1%) | 9 (37.5%) | | |
| **I attend advanced training courses about recycling.** | | | | | | | |
| No | 54 (51.9%) | 27 (49.1%) | 13 (72.2%) | 3 (42.9%) | 11 (45.8%) | 3.751 | 0.275 |
| Yes | 50 (48.1%) | 28 (50.9%) | 5 (27.8%) | 4 (57.1%) | 13 (54.2%) | | |
| **How did you get to know more about sustainability and recycling?** | | | | | | | |
| Internet | 66 (63.5%) | 39 (70.9%) | 10 (55.6%) | 4 (57.1%) | 13 (54.2%) | 3.018 | 0.376 |
| News | 35 (33.7%) | 20 (36.4%) | 5 (27.8%) | 3 (42.9%) | 7 (29.2%) | 1.028 | 0.830 |
| Training courses | 33 (31.7%) | 21 (38.2%) | 4 (22.2%) | 3 (42.9%) | 5 (20.8%) | 3.492 | 0.339 |
| Conferences | 24 (23.1%) | 12 (21.8%) | 4 (22.2%) | 2 (28.6%) | 6 (25.0%) | 0.521 | 0.946 |
| Environmental protection campaign | 21 (20.2%) | 16 (29.1%) | 3 (16.7%) | 0 (0.0%) | 2 (8.3%) | 5.859 | 0.096 |
| Friends or family | 18 (17.3%) | 16 (29.1%) | 1 (5.6%) | 1 (14.3%) | 0 (0.0%) | 12.505* | 0.004* |
| Personal involvement in environmental protection activities | 13 (12.5%) | 9 (16.4%) | 1 (5.6%) | 1 (14.3%) | 2 (8.3%) | 1.774 | 0.615 |
| Radio | 9 (8.7%) | 8 (14.5%) | 0 (0.0%) | 1 (14.3%) | 0 (0.0%) | 6.273 | 0.058 |

$\chi^2$: **Chi-square test** MC: **Monte Carlo**

p: p-value for Relationship between **years of experience** and **sustainability background and training**

*: Statistically significant at $p \leq 0.05$

Perceptions of global warming and local climate change

The analysis of the relationship between years' of experience and perceptions of climate change yielded several notable findings. Firstly, a significant correlation was identified concerning the belief that serious pollution contributes to global warming ($\chi^2 = 8.096$, $p = 0.038$). Additionally, the perception that human activities are the primary cause of climate change exhibited a strong correlation ($\chi^2 = 22.68$, $p = 0.011$). Furthermore, participation in environmental protection

activities was significantly associated with years of experience ($\chi^2$ = 19.268, p = 0.033). Respondents who perceived that climate change has impacted their local region also demonstrated a significant association ($\chi^2$ = 22.478, p = 0.012). Finally, the belief that climate change results in a natural ecological crisis was found to be significant ($\chi^2$ = 14.807, p = 0.015) (**Table 3**).

**Table 3: Relation between years' of experience and climate change and global warming (n = 104)**

| Climate change and global warming | Total (n = 104) | Years of experience 1 - 3 (n = 55) | 4 - 6 (n = 18) | 7 - 9 (n = 7) | >9 (n = 24) | $\chi^2$ | $^{MC}p$ |
|---|---|---|---|---|---|---|---|
| **I am well-informed about climate change and the impact that human action has on the natural world.** | | | | | | | |
| Strongly disagree | 8 (7.7%) | 4 (7.3%) | 2 (11.1%) | 0 (0.0%) | 2 (8.3%) | | |
| Disagree | 7 (6.7%) | 2 (3.6%) | 3 (16.7%) | 0 (0.0%) | 2 (8.3%) | | |
| Neutral | 18 (17.3%) | 10 (18.2%) | 1 (5.6%) | 2 (28.6%) | 5 (20.8%) | 13.758 | 0.233 |
| Agree | 40 (38.5%) | 23 (41.8%) | 7 (38.9%) | 5 (71.4%) | 5 (20.8%) | | |
| Strongly agree | 31 (29.8%) | 16 (29.1%) | 5 (27.8%) | 0 (0.0%) | 10 (41.7%) | | |
| **I am concerned about climate change and the impact people are having on the environment.** | | | | | | | |
| Strongly disagree | 7 (6.7%) | 4 (7.3%) | 1 (5.6%) | 0 (0.0%) | 2 (8.3%) | | |
| Disagree | 3 (2.9%) | 1 (1.8%) | 1 (5.6%) | 0 (0.0%) | 1 (4.2%) | | |
| Neutral | 23 (22.1%) | 13 (23.6%) | 3 (16.7%) | 3 (42.9%) | 4 (16.7%) | 13.819 | 0.218 |
| Agree | 40 (38.5%) | 18 (32.7%) | 11 (61.1%) | 4 (57.1%) | 7 (29.2%) | | |
| Strongly agree | 31 (29.8%) | 19 (34.5%) | 2 (11.1%) | 0 (0.0%) | 10 (41.7%) | | |
| **What do you think are the reasons for global warming?** | | | | | | | |
| Serious pollution | 71 (68.3%) | 43 (78.2%) | 11 (61.1%) | 2 (28.6%) | 15 (62.5%) | 8.096* | 0.038* |
| Population explosion | 69 (66.3%) | 35 (63.6%) | 12 (66.7%) | 6 (85.7%) | 16 (66.7%) | 1.193 | 0.800 |
| Forest, and farmland destroyed | 60 (57.7%) | 37 (67.3%) | 11 (61.1%) | 3 (42.9%) | 9 (37.5%) | 6.749 | 0.076 |
| Motor vehicles increasing | 60 (57.7%) | 34 (61.8%) | 8 (44.4%) | 2 (28.6%) | 16 (66.7%) | 4.755 | 0.181 |
| Changes in the atmosphere | 57 (54.8%) | 33 (60.0%) | 8 (44.4%) | 3 (42.9%) | 13 (54.2%) | 1.868 | 0.606 |
| Rapid development of the industry | 54 (51.9%) | 34 (61.8%) | 5 (27.8%) | 4 (57.1%) | 11 (45.8%) | 6.778 | 0.074 |
| Greenhouse effect | 39 (37.5%) | 21 (38.2%) | 6 (33.3%) | 2 (28.6%) | 10 (41.7%) | 0.572 | 0.934 |
| Ecological environment deterioration | 37 (35.6%) | 16 (29.1%) | 7 (38.9%) | 1 (14.3%) | 13 (54.2%) | 5.775 | 0.112 |
| Process of Rural Urbanization | 32 (30.8%) | 18 (32.7%) | 4 (22.2%) | 3 (42.9%) | 7 (29.2%) | 1.318 | 0.722 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Others | 3 (2.9%) | 1 (1.8%) | 1 (5.6%) | 1 (14.3%) | 0 (0.0%) | 4.372 | 0.141 |
| **Human activities (compared to natural factors) are the main cause of climate change.** | | | | | | | |
| Strongly disagree | 1 (1.0%) | 1 (1.8%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 1 (1.0%) | 0 (0.0%) | 1 (5.6%) | 0 (0.0%) | 0 (0.0%) | | |
| Neutral | 19 (18.3%) | 12 (21.8%) | 2 (11.1%) | 1 (14.3%) | 4 (16.7%) | 22.680* | 0.011* |
| Agree | 42 (40.4%) | 17 (30.9%) | 12 (66.7%) | 6 (85.7%) | 7 (29.2%) | | |
| Strongly agree | 41 (39.4%) | 25 (45.5%) | 3 (16.7%) | 0 (0.0%) | 13 (54.2%) | | |
| **Global warming has already occurred.** | | | | | | | |
| Strongly disagree | 1 (1.0%) | 1 (1.8%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 2 (1.9%) | 2 (3.6%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Neutral | 24 (23.1%) | 12 (21.8%) | 5 (27.8%) | 1 (14.3%) | 6 (25.0%) | 11.167 | 0.553 |
| Agree | 45 (43.3%) | 22 (40.0%) | 9 (50.0%) | 6 (85.7%) | 8 (33.3%) | | |
| Strongly agree | 32 (30.8%) | 18 (32.7%) | 4 (22.2%) | 0 (0.0%) | 10 (41.7%) | | |
| **Do you think developed countries or developing countries need to take greater responsibility for global climate change?** | | | | | | | |
| The former | 20 (19.2%) | 9 (16.4%) | 7 (38.9%) | 2 (28.6%) | 2 (8.3%) | | |
| The latter | 1 (1.0%) | 1 (1.8%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Both responsibilities fairly | 62 (59.6%) | 33 (60.0%) | 9 (50.0%) | 3 (42.9%) | 17 (70.8%) | 14.336 | 0.221 |
| Differentiated responsibilities | 12 (11.5%) | 6 (10.9%) | 0 (0.0%) | 2 (28.6%) | 4 (16.7%) | | |
| Unable to explain clearly | 9 (8.7%) | 6 (10.9%) | 2 (11.1%) | 0 (0.0%) | 1 (4.2%) | | |
| **Climate change can be avoided.** | | | | | | | |
| Strongly disagree | 1 (1.0%) | 1 (1.8%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 8 (7.7%) | 5 (9.1%) | 0 (0.0%) | 0 (0.0%) | 3 (12.5%) | | |
| Neutral | 34 (32.7%) | 19 (34.5%) | 7 (38.9%) | 3 (42.9%) | 5 (20.8%) | 9.458 | 0.723 |
| Agree | 33 (31.7%) | 19 (34.5%) | 5 (27.8%) | 1 (14.3%) | 8 (33.3%) | | |
| Strongly agree | 28 (26.9%) | 11 (20.0%) | 6 (33.3%) | 3 (42.9%) | 8 (33.3%) | | |
| **If someone called for it, I would like to join the actual efforts to mitigate climate change.** | | | | | | | |
| Strongly disagree | 2 (1.9%) | 2 (3.6%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 2 (1.9%) | 0 (0.0%) | 1 (5.6%) | 0 (0.0%) | 1 (4.2%) | | |
| Neutral | 25 (24.0%) | 17 (30.9%) | 4 (22.2%) | 1 (14.3%) | 3 (12.5%) | 11.555 | 0.437 |
| Agree | 53 (51.0%) | 26 (47.3%) | 11 (61.1%) | 4 (57.1%) | 12 (50.0%) | | |
| Strongly agree | 22 (21.2%) | 10 (18.2%) | 2 (11.1%) | 2 (28.6%) | 8 (33.3%) | | |
| **I am willing to sacrifice some individual benefit to solve existing problems.** | | | | | | | |
| Strongly disagree | 2 (1.9%) | 1 (1.8%) | 0 (0.0%) | 0 (0.0%) | 1 (4.2%) | | |
| Disagree | 3 (2.9%) | 1 (1.8%) | 1 (5.6%) | 0 (0.0%) | 1 (4.2%) | 10.380 | 0.545 |
| Neutral | 26 (25.0%) | 15 (27.3%) | 5 (27.8%) | 2 (28.6%) | 4 (16.7%) | | |
| Agree | 50 (48.1%) | 28 (50.9%) | 9 (50.0%) | 1 (14.3%) | 12 (50.0%) | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Strongly agree | 23 (22.1%) | 10 (18.2%) | 3 (16.7%) | 4 (57.1%) | 6 (25.0%) | | |
| **I do participate in some environmental protection activities related to climate change.** | | | | | | | |
| Strongly disagree | 4 (3.8%) | 1 (1.8%) | 3 (16.7%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 6 (5.8%) | 3 (5.5%) | 1 (5.6%) | 0 (0.0%) | 2 (8.3%) | | |
| Neutral | 35 (33.7%) | 25 (45.5%) | 4 (22.2%) | 3 (42.9%) | 3 (12.5%) | 19.268* | 0.033* |
| Agree | 38 (36.5%) | 18 (32.7%) | 6 (33.3%) | 1 (14.3%) | 13 (54.2%) | | |
| Strongly agree | 21 (20.2%) | 8 (14.5%) | 4 (22.2%) | 3 (42.9%) | 6 (25.0%) | | |
| **Climate change has happened in my local region.** | | | | | | | |
| Strongly disagree | 1 (1.0%) | 0 (0.0%) | 1 (5.6%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 2 (1.9%) | 1 (1.8%) | 1 (5.6%) | 0 (0.0%) | 0 (0.0%) | | |
| Neutral | 29 (27.9%) | 17 (30.9%) | 6 (33.3%) | 4 (57.1%) | 2 (8.3%) | 22.478* | 0.012* |
| Agree | 45 (43.3%) | 27 (49.1%) | 5 (27.8%) | 0 (0.0%) | 13 (54.2%) | | |
| Strongly agree | 27 (26.0%) | 10 (18.2%) | 5 (27.8%) | 3 (42.9%) | 9 (37.5%) | | |
| **What kind of impacts will climate change bring to us?** | | | | | | | |
| None | 4 (3.8%) | 1 (1.8%) | 1 (5.6%) | 0 (0.0%) | 2 (8.3%) | | |
| Positive effects | 17 (16.3%) | 8 (14.5%) | 3 (16.7%) | 0 (0.0%) | 6 (25.0%) | | |
| Negative effects | 44 (42.3%) | 23 (41.8%) | 6 (33.3%) | 5 (71.4%) | 10 (41.7%) | 7.706 | 0.517 |
| Both positive effects and negative effects | 39 (37.5%) | 23 (41.8%) | 8 (44.4%) | 2 (28.6%) | 6 (25.0%) | | |
| **How did you perceive your well-being during climate change?** | | | | | | | |
| Work fatigue and low efficiency | 69 (66.3%) | 32 (58.2%) | 15 (83.3%) | 4 (57.1%) | 18 (75.0%) | 5.006 | 0.164 |
| Outdoor activity affected | 58 (55.8%) | 32 (58.2%) | 9 (50.0%) | 5 (71.4%) | 12 (50.0%) | 1.389 | 0.715 |
| Poor personal comfort | 49 (47.1%) | 24 (43.6%) | 10 (55.6%) | 1 (14.3%) | 14 (58.3%) | 4.865 | 0.174 |
| Decreased appetite | 35 (33.7%) | 19 (34.5%) | 5 (27.8%) | 1 (14.3%) | 10 (41.7%) | 1.953 | 0.600 |
| Affects contact with others | 33 (31.7%) | 19 (34.5%) | 4 (22.2%) | 3 (42.9%) | 7 (29.2%) | 1.495 | 0.691 |
| Lethargy | 32 (30.8%) | 18 (32.7%) | 7 (38.9%) | 2 (28.6%) | 5 (20.8%) | 1.850 | 0.621 |
| Rising energy fee | 30 (28.8%) | 11 (20.0%) | 5 (27.8%) | 2 (28.6%) | 12 (50.0%) | 7.078 | 0.062 |
| Not sleeping well | 25 (24.0%) | 14 (25.5%) | 5 (27.8%) | 2 (28.6%) | 4 (16.7%) | 1.191 | 0.774 |
| **Influences of climate change** | | | | | | | |
| **Increasing extreme weather (storms, floods, droughts, hurricanes, etc.)** | | | | | | | |
| Strongly disagree | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 2 (1.9%) | 0 (0.0%) | 2 (11.1%) | 0 (0.0%) | 0 (0.0%) | | |
| Don’t Know | 11 (10.6%) | 6 (10.9%) | 2 (11.1%) | 1 (14.3%) | 2 (8.3%) | 8.518 | 0.443 |
| Agree | 46 (44.2%) | 27 (49.1%) | 5 (27.8%) | 3 (42.9%) | 11 (45.8%) | | |
| Strongly agree | 45 (43.3%) | 22 (40.0%) | 9 (50.0%) | 3 (42.9%) | 11 (45.8%) | | |
| **Affecting human health** | | | | | | | |
| Strongly disagree | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 5.973 | 0.391 |
| Disagree | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Don't Know | 9 (8.7%) | 5 (9.1%) | 2 (11.1%) | 2 (28.6%) | 0 (0.0%) | | |
| Agree | 54 (51.9%) | 28 (50.9%) | 10 (55.6%) | 3 (42.9%) | 13 (54.2%) | | |
| Strongly agree | 41 (39.4%) | 22 (40.0%) | 6 (33.3%) | 2 (28.6%) | 11 (45.8%) | | |
| **Affecting agricultural production** | | | | | | | |
| Strongly disagree | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 1 (1.0%) | 1 (1.8%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Don't Know | 13 (12.5%) | 6 (10.9%) | 3 (16.7%) | 2 (28.6%) | 2 (8.3%) | 7.797 | 0.617 |
| Agree | 47 (45.2%) | 28 (50.9%) | 7 (38.9%) | 1 (14.3%) | 11 (45.8%) | | |
| Strongly agree | 43 (41.3%) | 20 (36.4%) | 8 (44.4%) | 4 (57.1%) | 11 (45.8%) | | |
| **Initiating a natural ecological crisis** | | | | | | | |
| Strongly disagree | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Don't Know | 17 (16.3%) | 6 (10.9%) | 5 (27.8%) | 4 (57.1%) | 2 (8.3%) | 14.807* | 0.015* |
| Agree | 46 (44.2%) | 30 (54.5%) | 6 (33.3%) | 0 (0.0%) | 10 (41.7%) | | |
| Strongly agree | 41 (39.4%) | 19 (34.5%) | 7 (38.9%) | 3 (42.9%) | 12 (50.0%) | | |
| **Sea-level rise and submerge low-lying area** | | | | | | | |
| Strongly disagree | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Don't Know | 18 (17.3%) | 10 (18.2%) | 4 (22.2%) | 3 (42.9%) | 1 (4.2%) | 11.022 | 0.071 |
| Agree | 38 (36.5%) | 24 (43.6%) | 3 (16.7%) | 2 (28.6%) | 9 (37.5%) | | |
| Strongly agree | 48 (46.2%) | 21 (38.2%) | 11 (61.1%) | 2 (28.6%) | 14 (58.3%) | | |
| **The increasing threat of infectious diseases** | | | | | | | |
| Strongly disagree | 1 (1.0%) | 1 (1.8%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 1 (1.0%) | 1 (1.8%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Don't Know | 16 (15.4%) | 7 (12.7%) | 4 (22.2%) | 2 (28.6%) | 3 (12.5%) | 10.822 | 0.659 |
| Agree | 44 (42.3%) | 28 (50.9%) | 5 (27.8%) | 2 (28.6%) | 9 (37.5%) | | |
| Strongly agree | 42 (40.4%) | 18 (32.7%) | 9 (50.0%) | 3 (42.9%) | 12 (50.0%) | | |

$\chi^2$: **Chi-square test** MC: **Monte Carlo**

p: p-value for Relation between **years of experience** and **climate change and global warming**

*: Statistically significant at $p \leq 0.05$

Sustainability practices in radiography

The analysis yielded significant findings pertaining to sustainability practices within the field of radiography, particularly as influenced by years of professional experience. A noteworthy association was identified with the implementation of energy-efficient heating practices ($\chi^2 = 10.482$, $p = 0.011$). Additionally, a significant correlation was observed concerning the recycling of imaging and contrast media waste, with marked differences noted across varying levels of experience ($\chi^2 = 25.778$, $p = 0.004$) (**Table 4**).

**Table 4: Relation between years' of experience and sustainability practices in radiography (n = 104)**

| Sustainability practices in radiography. | Total (n = 104) | Years of experience 1 - 3 (n = 55) | 4 - 6 (n = 18) | 7 - 9 (n = 7) | >9 (n = 24) | $\chi^2$ | $^{MC}p$ |
|---|---|---|---|---|---|---|---|
| **Your department/clinic could do more to improve its sustainability.** | | | | | | | |
| Strongly disagree | 1 (1.0%) | 1 (1.8%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Disagree | 2 (1.9%) | 2 (3.6%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Neutral | 26 (25.0%) | 14 (25.5%) | 6 (33.3%) | 2 (28.6%) | 4 (16.7%) | 11.336 | 0.527 |
| Agree | 46 (44.2%) | 28 (50.9%) | 6 (33.3%) | 3 (42.9%) | 9 (37.5%) | | |
| Strongly agree | 29 (27.9%) | 10 (18.2%) | 6 (33.3%) | 2 (28.6%) | 11 (45.8%) | | |
| **Does your department/clinic do any of the following to reduce energy and emissions?** | | | | | | | |
| Use of low-energy lighting | 62 (59.6%) | 35 (63.6%) | 10 (55.6%) | 3 (42.9%) | 14 (58.3%) | 1.449 | 0.711 |
| Use of a real-time power monitoring tool | 43 (41.3%) | 23 (41.8%) | 6 (33.3%) | 1 (14.3%) | 13 (54.2%) | 3.996 | 0.249 |
| Encourage staff to cycle | 34 (32.7%) | 16 (29.1%) | 7 (38.9%) | 5 (71.4%) | 6 (25.0%) | 5.636 | 0.119 |
| Energy-efficient heating | 33 (31.7%) | 17 (30.9%) | 1 (5.6%) | 3 (42.9%) | 12 (50.0%) | 10.482* | 0.011* |
| Energy-efficient appliances | 31 (29.8%) | 19 (34.5%) | 4 (22.2%) | 0 (0.0%) | 8 (33.3%) | 3.993 | 0.257 |
| Use of solar panel electricity | 31 (29.8%) | 18 (32.7%) | 3 (16.7%) | 3 (42.9%) | 7 (29.2%) | 2.366 | 0.515 |
| Encourage staff to use public transport | 31 (29.8%) | 18 (32.7%) | 5 (27.8%) | 3 (42.9%) | 5 (20.8%) | 1.857 | 0.598 |
| Emission reduction policy | 30 (28.8%) | 14 (25.5%) | 6 (33.3%) | 2 (28.6%) | 8 (33.3%) | 0.947 | 0.870 |
| Sensor taps to reduce water use | 26 (25.0%) | 17 (30.9%) | 3 (16.7%) | 0 (0.0%) | 6 (25.0%) | 3.544 | 0.302 |
| Encourage staff to car-pool | 26 (25.0%) | 13 (23.6%) | 4 (22.2%) | 1 (14.3%) | 8 (33.3%) | 1.314 | 0.743 |
| Use of electricity providers that use renewable sources | 23 (22.1%) | 11 (20.0%) | 4 (22.2%) | 0 (0.0%) | 8 (33.3%) | 3.470 | 0.306 |
| Provide information about public transport | 20 (19.2%) | 12 (21.8%) | 3 (16.7%) | 1 (14.3%) | 4 (16.7%) | 0.437 | 0.957 |
| Audits of energy use or emission | 19 (18.3%) | 10 (18.2%) | 5 (27.8%) | 0 (0.0%) | 4 (16.7%) | 2.266 | 0.527 |
| Retrofitting of insulation and/or double glazing | 16 (15.4%) | 7 (12.7%) | 3 (16.7%) | 0 (0.0%) | 6 (25.0%) | 2.785 | 0.391 |
| Others | 3 (2.9%) | 2 (3.6%) | 0 (0.0%) | 0 (0.0%) | 1 (4.2%) | 1.096 | 1.000 |
| **Does your department/clinic do any of the following to reduce waste?** | | | | | | | |
| Use double-sided printing | 52 (50.0%) | 27 (49.1%) | 7 (38.9%) | 3 (42.9%) | 15 (62.5%) | 2.568 | 0.476 |
| Re-use clinic equipment where appropriate | 46 (44.2%) | 21 (38.2%) | 8 (44.4%) | 2 (28.6%) | 15 (62.5%) | 4.646 | 0.194 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Schedule orders to reduce the frequency of deliveries | 40 (38.5%) | 24 (43.6%) | 4 (22.2%) | 1 (14.3%) | 11 (45.8%) | 4.666 | 0.200 |
| Audit their waste production | 40 (38.5%) | 20 (36.4%) | 5 (27.8%) | 4 (57.1%) | 11 (45.8%) | 2.578 | 0.462 |
| Recycle clinic waste | 36 (34.6%) | 17 (30.9%) | 4 (22.2%) | 5 (71.4%) | 10 (41.7%) | 5.903 | 0.109 |
| Buy recycled office supplies | 32 (30.8%) | 17 (30.9%) | 6 (33.3%) | 1 (14.3%) | 8 (33.3%) | 0.918 | 0.856 |
| Recycle theater waste | 27 (26.0%) | 18 (32.7%) | 3 (16.7%) | 2 (28.6%) | 4 (16.7%) | 3.086 | 0.370 |
| Compost food waste | 25 (24.0%) | 16 (29.1%) | 1 (5.6%) | 2 (28.6%) | 6 (25.0%) | 4.601 | 0.194 |
| Recycle Contrast media waste | 5 (4.8%) | 3 (5.5%) | 0 (0.0%) | 1 (14.3%) | 1 (4.2%) | 2.438 | 0.453 |
| **Which of the following statements apply to your department/clinic?** | | | | | | | |
| We have an acknowledged position on sustainability | 48 (46.2%) | 28 (50.9%) | 7 (38.9%) | 4 (57.1%) | 9 (37.5%) | 1.975 | 0.600 |
| Staff are offered training to improve department/clinic sustainability | 46 (44.2%) | 26 (47.3%) | 7 (38.9%) | 3 (42.9%) | 10 (41.7%) | 0.565 | 0.944 |
| Sustainability is discussed at department/clinic meetings | 41 (39.4%) | 27 (49.1%) | 3 (16.7%) | 2 (28.6%) | 9 (37.5%) | 6.410 | 0.090 |
| Patients and staff have avenues to suggest ways to improve sustainability | 39 (37.5%) | 24 (43.6%) | 4 (22.2%) | 2 (28.6%) | 9 (37.5%) | 2.820 | 0.421 |
| We offset carbon emissions in some way | 26 (25.0%) | 18 (32.7%) | 3 (16.7%) | 2 (28.6%) | 3 (12.5%) | 4.355 | 0.218 |
| **My concern about climate change has made me change my behaviors in my personal life** | | | | | | | |
| Strongly disagree | 8 (7.7%) | 3 (5.5%) | 1 (5.6%) | 1 (14.3%) | 3 (12.5%) | | |
| Disagree | 3 (2.9%) | 3 (5.5%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Neutral | 44 (42.3%) | 26 (47.3%) | 8 (44.4%) | 3 (42.9%) | 7 (29.2%) | 8.555 | 0.726 |
| Agree | 34 (32.7%) | 18 (32.7%) | 6 (33.3%) | 2 (28.6%) | 8 (33.3%) | | |
| Strongly agree | 15 (14.4%) | 5 (9.1%) | 3 (16.7%) | 1 (14.3%) | 6 (25.0%) | | |
| **Radiographers have a responsibility to be aware of the environmental impact of Imaging services** | | | | | | | |
| Strongly disagree | 5 (4.8%) | 1 (1.8%) | 0 (0.0%) | 1 (14.3%) | 3 (12.5%) | | |
| Disagree | 3 (2.9%) | 2 (3.6%) | 1 (5.6%) | 0 (0.0%) | 0 (0.0%) | | |
| Neutral | 21 (20.2%) | 12 (21.8%) | 4 (22.2%) | 3 (42.9%) | 2 (8.3%) | 13.843 | 0.219 |
| Agree | 46 (44.2%) | 27 (49.1%) | 8 (44.4%) | 2 (28.6%) | 9 (37.5%) | | |
| Strongly agree | 29 (27.9%) | 13 (23.6%) | 5 (27.8%) | 1 (14.3%) | 10 (41.7%) | | |
| **I recycle at home** | | | | | | | |
| Strongly disagree | 4 (3.8%) | 0 (0.0%) | 1 (5.6%) | 0 (0.0%) | 3 (12.5%) | | |
| Disagree | 10 (9.6%) | 4 (7.3%) | 3 (16.7%) | 0 (0.0%) | 3 (12.5%) | | |
| Neutral | 28 (26.9%) | 17 (30.9%) | 5 (27.8%) | 2 (28.6%) | 4 (16.7%) | 15.611 | 0.135 |
| Agree | 43 (41.3%) | 26 (47.3%) | 7 (38.9%) | 4 (57.1%) | 6 (25.0%) | | |
| Strongly agree | 19 (18.3%) | 8 (14.5%) | 2 (11.1%) | 1 (14.3%) | 8 (33.3%) | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Imaging and contrast media waste are usually recycled in the hospital I work in** | | | | | | | |
| Strongly disagree | 10 (9.6%) | 3 (5.5%) | 1 (5.6%) | 1 (14.3%) | 5 (20.8%) | | |
| Disagree | 23 (22.1%) | 8 (14.5%) | 7 (38.9%) | 0 (0.0%) | 8 (33.3%) | | |
| Neutral | 34 (32.7%) | 25 (45.5%) | 5 (27.8%) | 1 (14.3%) | 3 (12.5%) | 25.778* | 0.004* |
| Agree | 23 (22.1%) | 14 (25.5%) | 3 (16.7%) | 4 (57.1%) | 2 (8.3%) | | |
| Strongly agree | 14 (13.5%) | 5 (9.1%) | 2 (11.1%) | 1 (14.3%) | 6 (25.0%) | | |
| **I would like to recycle Radiographic waste** | | | | | | | |
| Strongly disagree | 9 (8.7%) | 1 (1.8%) | 2 (11.1%) | 1 (14.3%) | 5 (20.8%) | | |
| Disagree | 4 (3.8%) | 1 (1.8%) | 1 (5.6%) | 0 (0.0%) | 2 (8.3%) | | |
| Neutral | 26 (25.0%) | 18 (32.7%) | 3 (16.7%) | 2 (28.6%) | 3 (12.5%) | 18.387 | 0.056 |
| Agree | 37 (35.6%) | 20 (36.4%) | 9 (50.0%) | 3 (42.9%) | 5 (20.8%) | | |
| Strongly agree | 28 (26.9%) | 15 (27.3%) | 3 (16.7%) | 1 (14.3%) | 9 (37.5%) | | |

$\chi^2$: **Chi-square test** MC: **Monte Carlo**
p: p-value for Relation between **years of experience** and **Sustainability practices in radiography**
*: Statistically significant at $p \leq 0.05$

## Barriers to sustainable practices in radiography

The analysis of barriers to sustainability in medical imaging departments revealed a statistically significant association between years of experience and the barrier identified as "Lack of Authority to Make Change" ($\chi^2 = 9.449$, $p = 0.022$; **Table 5**).

**Table 5: Relation between years' of experience and barriers to sustainability (n = 104)**

| Barriers to sustainability | Total (n = 104) | Years' of experience 1 - 3 (n = 55) | 4 - 6 (n = 18) | 7 - 9 (n = 7) | >9 (n = 24) | $\chi^2$ | $^{MC}p$ |
|---|---|---|---|---|---|---|---|
| **Which of the following is a potential barrier to sustainability in radiology departments** | | | | | | | |
| Staff attitude | 56 (53.8%) | 26 (47.3%) | 9 (50.0%) | 4 (57.1%) | 17 (70.8%) | 3.929 | 0.276 |
| Cost | 53 (51.0%) | 30 (54.5%) | 9 (50.0%) | 3 (42.9%) | 11 (45.8%) | 0.819 | 0.863 |
| Time | 52 (50.0%) | 31 (56.4%) | 7 (38.9%) | 2 (28.6%) | 12 (50.0%) | 2.995 | 0.386 |
| Lack of leadership | 50 (48.1%) | 25 (45.5%) | 8 (44.4%) | 3 (42.9%) | 14 (58.3%) | 1.401 | 0.731 |
| Lack of Authority to make change | 47 (45.2%) | 25 (45.5%) | 12 (66.7%) | 0 (0.0%) | 10 (41.7%) | 9.449* | 0.022* |
| Lack of support from colleagues | 44 (42.3%) | 27 (49.1%) | 5 (27.8%) | 1 (14.3%) | 11 (45.8%) | 4.742 | 0.189 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Safety | 37 (35.6%) | 19 (34.5%) | 5 (27.8%) | 1 (14.3%) | 12 (50.0%) | 3.751 | 0.295 |
| Inadequate training and information | 37 (35.6%) | 20 (36.4%) | 7 (38.9%) | 1 (14.3%) | 9 (37.5%) | 1.404 | 0.736 |
| Facility | 33 (31.7%) | 17 (30.9%) | 7 (38.9%) | 2 (28.6%) | 7 (29.2%) | 0.660 | 0.932 |
| **Which of the following is the greatest barrier to sustainability in** medical imaging **departments** | | | | | | | |
| Lack of leadership | 21 (20.2%) | 9 (16.4%) | 6 (33.3%) | 1 (14.3%) | 5 (20.8%) | | |
| Inadequate training and information | 20 (19.2%) | 12 (21.8%) | 3 (16.7%) | 1 (14.3%) | 4 (16.7%) | | |
| Staff attitude | 18 (17.3%) | 5 (9.1%) | 3 (16.7%) | 2 (28.6%) | 8 (33.3%) | | |
| Safety | 12 (11.5%) | 9 (16.4%) | 1 (5.6%) | 1 (14.3%) | 1 (4.2%) | | |
| Lack of authority to make change | 11 (10.6%) | 6 (10.9%) | 1 (5.6%) | 0 (0.0%) | 4 (16.7%) | 25.276 | 0.234 |
| Cost | 8 (7.7%) | 3 (5.5%) | 3 (16.7%) | 1 (14.3%) | 1 (4.2%) | | |
| Time | 7 (6.7%) | 7 (12.7%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | | |
| Facility | 4 (3.8%) | 3 (5.5%) | 0 (0.0%) | 1 (14.3%) | 0 (0.0%) | | |
| Lack of support from colleagues | 3 (2.9%) | 1 (1.8%) | 1 (5.6%) | 0 (0.0%) | 1 (4.2%) | | |
| **To increase recycling in** medical imaging **departments I am willing to provide the following** | | | | | | | |
| Time to educate myself | 77 (74.0%) | 42 (76.4%) | 12 (66.7%) | 5 (71.4%) | 18 (75.0%) | 0.955 | 0.857 |
| Time to educate others | 60 (57.7%) | 35 (63.6%) | 6 (33.3%) | 3 (42.9%) | 16 (66.7%) | 6.470 | 0.093 |
| Funds to educate others | 31 (29.8%) | 17 (30.9%) | 2 (11.1%) | 2 (28.6%) | 10 (41.7%) | 4.761 | 0.182 |
| Funds to educate myself | 28 (26.9%) | 16 (29.1%) | 1 (5.6%) | 3 (42.9%) | 8 (33.3%) | 6.326 | 0.084 |
| None of the above | 11 (10.6%) | 7 (12.7%) | 4 (22.2%) | 0 (0.0%) | 0 (0.0%) | 5.952 | 0.082 |

$\chi^2$: **Chi-square test** MC: **Monte Carlo**

p: p-value for Relation between **years of experience** and **Barriers to sustainability**

*: Statistically significant at $p \leq 0.05$

**Discussion**

As the global healthcare sector continues to confront the urgent need to mitigate its environmental impact and promote sustainable practices, there exists a critical necessity to educate radiographers regarding the significance of these initiatives. Leveraging their credibility and authority within healthcare settings, radiographers can significantly contribute to fostering a culture of environmental responsibility and resilience. By drawing on the expertise and leadership of seasoned radiographers, healthcare organizations can facilitate the advancement of sustainable practices in radiography, ultimately contributing to a greener and more sustainable future for healthcare delivery. Consequently, it is imperative to investigate the role of experienced radiographers in this initiative to ensure that educational efforts effectively address the needs of radiographers. Nevertheless, despite the growing acknowledgment of sustainability as a vital concern [10, 27-30] the specific impact of radiographers' experience on the perception and implementation of sustainability within the field of radiography remains largely unexamined.

The present study highlighted a significant relationship between years' of experience and sources of information regarding sustainability, particularly emphasizing the critical role of social networks. Friends and family emerged as key sources of knowledge, underscoring how personal connections shape individuals' understanding of sustainable practices such as recycling. This suggests that socialization is essential for fostering sustainable behaviors, as individuals are more likely to adopt these practices when supported by trusted sources. Future initiatives could enhance sustainability awareness by leveraging social influences and promoting community engagement and peer-led educational efforts.

The findings of this study closely align with those of Ohene-Botwe's (2024) research, which underscores the crucial role of experience in enhancing climate change awareness among radiographers in resource-limited settings. The research indicates that seasoned professionals are often better equipped to implement sustainable practices[31].

Our study revealed that an increase in years' of experience correlates with an enhanced awareness of the effects of pollution and the human impact on the environment. Participants exhibited a greater propensity to engage in environmental protection activities and to recognize the local ramifications of climate change.

Additionally, our study indicates that experience in radiography plays a critical role in shaping sustainability practices. Radiographers with more extensive experience are more inclined to implement energy-efficient heating solutions and demonstrate a strong commitment to recycling imaging and contrast media waste. These findings align with Roletto et al. (2024), which underscore the importance of managing energy consumption in radiology to mitigate environmental impact[32].

While efforts have been made to integrate sustainability into the competencies of medical imaging, additional measures are necessary for comprehensive implementation. Creating environmentally conscious learning environments, such as "green" classrooms[33, 34], is essential. This transition requires a responsible and proactive approach from radiographers, which includes behaviors such as dietary modifications, energy optimization, image retake reduction, appropriate contrast media use, material recycling, and utilization of public transportation. Furthermore, the continuous professional development of individuals working in healthcare institutions is crucial to ensure their ability to navigate dynamic environmental changes [35–38]. Therefore, it is essential to make concerted global efforts in this direction, particularly through the consolidation of research activities in the fields of medical imaging and environmental health. This consolidation will produce significant findings and support leadership initiatives in medical imaging[11, 17, 39, 40].

The alignment of findings between the present study and the study by Doo. et al[28]. reported that climate change is a major concern, with radiology contributing up to one percent of overall emissions. To mitigate its impact, radiographers should focus on sustainability. Forming a dedicated team focused on sustainability within the medical imaging department is essential for effectively managing efforts to reduce environmental impact. Additionally, it is imperative to construct a dashboard as a monitoring tool that collects and displays relevant data or key metrics, such as energy consumption, waste reduction, and resource utilization. By systematically tracking these metrics, the sustainability team can identify areas for improvement, monitor progress, and ensure that the department is making significant strides toward adopting more environmentally friendly practices.

High-impact interventions encompass the transition to reusable medical supplies, the deactivation of climate control systems, and the powering down of equipment when not in use. The implementation of decision-support tools, the optimization of imaging protocols, and the expansion of clinical low-field MRI applications have the potential to mitigate health inequities.

Collaboration with manufacturers and the establishment of sustainable waste management programs can further contribute to the reduction of packaging waste[29].

The findings indicate a complex relationship between years of experience and engagement in sustainability practices within medical imaging departments and clinics. While certain practices, such as the implementation of low-energy lighting, are widely adopted irrespective of experience level, other practices exhibit significant variability. This variability suggests the potential for specific areas where targeted interventions or educational initiatives may prove beneficial. Furthermore, the respondents' organizational commitment to sustainability and their attitudes toward environmental responsibility are found to vary, underscoring the necessity of customized approaches to promote sustainable practices in radiography.

The current work findings underscore the intricate relationship between professional experience and the barriers to sustainability within medical imaging departments. As individuals progress in their careers, they acquire a deeper understanding of organizational dynamics that may hinder the implementation of sustainable practices, particularly concerning authority and leadership. Addressing these challenges demands not only the establishment of educational programs but also the implementation of strategic interventions that empower individuals to effect change within their organizational contexts. Furthermore, the respondents' willingness to engage in recycling initiatives illustrates the potential for collaborative efforts to surmount obstacles and promote sustainability in radiographic practice. Collaborative and empowerment initiatives are pivotal in advancing sustainable practices. It is essential to address organizational barriers to effectively execute these initiatives, acknowledging that varying levels of experience will necessitate distinct educational methodologies and strategies. On a global scale, it is crucial to integrate research in medical imaging and environmental health to cultivate and enhance leadership in sustainable radiography practices.

The present study encounters limitations that warrant careful consideration. The study's reliance on a sample size of 104 radiographers from a global perspective may restrict the generalizability of the findings, potentially overlooking insights from radiographers with extensive experience or those in leadership roles. The use of an online questionnaire may introduce a bias toward individuals with advanced technological proficiency, while the self-reported nature of the data could lead to an overrepresentation of respondents who are more actively engaged in

sustainability initiatives. Furthermore, the absence of detailed geographic information and the uneven distribution of participants across regions may affect the global applicability of the study. Addressing the issue of low response rates is essential; therefore, implementing strategies to enhance participant engagement and increase survey completion is advisable. This may include sending invitations to potential participants and utilizing reminder emails at strategic intervals to encourage completion of the survey. The precise evaluation of questionnaire circulation and response rates was hindered by the varied distribution channels employed. In addition, collaborating with professional organizations to endorse the study and increase visibility among the target audience could further enhance response rates and ensure a more representative sample. This approach would help mitigate the risk of low response rates and strengthen the validity of the study's findings.

In conclusion, this research elucidates the intricate relationship between professional experience and perceptions of sustainability within medical imaging departments. It underscores the pivotal role of social networks in enhancing awareness, emphasizes the necessity for comprehensive education regarding the causes of climate change, and advocates for tailored strategies to promote sustainable practices. The findings further highlight the influence of organizational barriers that become increasingly apparent as professionals advance in their careers. By empowering individuals, fostering collaboration, and promoting global cooperation, the healthcare sector can make significant strides toward a greener and more sustainable future in radiography practice. Consolidating research activities in medical imaging and environmental health is likely to yield meaningful insights and bolster leadership initiatives critical for advancing sustainability in the field.

Our study strongly advocates for the promotion of sustainability in radiography. It is essential to establish formal networks to enhance awareness and collaboration, develop specialized educational programs focused on climate change and sustainable practices, address organizational barriers through targeted interventions and policy reforms, and encourage greater collaboration within the healthcare sector to drive sustainable practices and innovation.

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