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Research Article

Research activity among diagnostic and therapeutic radiographers: An international survey

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ABSTRACT

Introduction: Various national solutions have been considered and implemented to address the factors which limit radiographer engagement in conducting research. Nevertheless, national literature continues to suggest that radiographer engagement in research remains low. The aim of this study was to extend the existing evidence base by conducting an international survey to assess diagnostic radiographers and therapeutic radiographers involvement with, barriers to and support mechanisms for research.

Methods: Data collection was obtained via an online questionnaire which was distributed by the International Society of Radiographers and Radiologic Technologists (ISRRT). The study population included an international sample of qualified diagnostic radiographers and therapeutic radiographers across clinical and academic contexts in a variety of different roles such as clinical practice, management, education and research.

Results: In total, 420 diagnostic radiographers and therapeutic radiographers completed the survey. Multiple reasons were identified that were considered to inhibit respondents from conducting research. 69.3% indicated a combination of reasons for lack of engagement with research, rather than one single issue. Examples of reasons include: lack of time, insufficient research funding, limited research expertise, and lack of a suitable mentorship scheme.

Conclusion: A minor segment of survey respondents indicated involvement in research activity. Lack of dedicated time to research, mentors, and funding were among the main barriers to conduct research. Further research is required to explore what solutions are available to overcoming the barriers.

RÉSUMÉ

Introduction: Différentes solutions nationales ont été envisagées et mises en œuvre pour traiter les facteurs qui limitent l'engagement des radiographes dans la recherche. Néanmoins, la littérature nationale continue de suggérer que l'engagement des radiographes dans la recherche reste faible. L'objectif de cette étude était d'élargir la base

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Ethical approval: The ethics committee of the country and university initiating this survey concluded the need for ethical approval as unnecessary.

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de données existante en menant une enquête internationale pour évaluer l'implication des radiographes de diagnostic et des radiographes thérapeutiques dans la recherche, les obstacles à cette dernière et les mécanismes de soutien à la recherche.

Méthodologie: Les données ont été recueillies au moyen d'un questionnaire en ligne distribué par la Société internationale des radiographes et des technologues en radiologie (ISRRT). La population étudiée comprenait un échantillon international de radiographes diagnostiques et de radiographes thérapeutiques qualifiés dans des contextes cliniques et universitaires, dans une variété de rôles différents tels que la pratique clinique, la gestion, l'éducation et la recherche.

Résultats: Au total, 420 radiographes de diagnostic et radiographes thérapeutiques ont répondu à l'enquête. De multiples raisons ont été évoquées pour empêcher les personnes interrogées de mener des recherches. 69,3 % ont indiqué une combinaison de raisons pour expliquer leur manque d'engagement dans la recherche, plutôt qu'un seul problème. Les exemples de raisons comprennent : le manque de temps, le financement insuffisant de la recherche, l'expertise limitée en matière de recherche et l'absence d'un programme de mentorat approprié.

Conclusion: Une petite partie des répondants à l'enquête a indiqué participer à des activités de recherche. Le manque de temps consacré à la recherche, de mentors et de financement figure parmi les principaux obstacles à la recherche. Des recherches supplémentaires seront nécessaires pour explorer les solutions disponibles pour surmonter ces obstacles.

Keywords: Education; Research; Radiographer; Radiography; Therapeutic radiographers

Introduction

A global need exists for health care professionals to be up to date with relevant research evidence in order to integrate it within their practice [1–3]. Carrying out research in radiography ensures the continued development and improvement of diagnostic imaging and radiation therapy, which benefits patients and, their clinical outcomes [4]. Additionally, research is one of the essential attributes which permits a profession to label itself as a profession. Being research active enables a profession to define it is own knowledge base and in turn this helps characterize professional identity and give it credibility [5].

Technology advances rapidly and the radiography profession must adapt as it accommodates such advances. A contemporary example of a technological advancement, which is on the cusp of impacting the radiography profession, is artificial intelligence (AI) [6]. Proactive radiographers are essential, requiring the capacity to consistently enhance their knowledge and skills to accommodate the integration of evidence and technologies into their practice. Not surprisingly, in many countries, a professional mandate exists for radiographers to use research evidence in their practice and this trend has grown steadily in the last decade [7]. In contrast, radiographer participation in the research process has been reported as low and unsatisfactory [8–10]. Previous national studies have identified some factors influencing this low involvement, including lack of time and lack of dedicated research time [11,12], lack of research funds [13], heavy workloads [14], lack of collaboration opportunities, low levels of self-motivation and lack of knowledge and skills to conduct research [13,15].

Considering the challenges involved, a range of approaches have been implemented to help diagnostic radiographers and therapeutic radiographers become involved with research and to utilise research in their practice. For example, within the United Kingdom, the College of Radiographers (CoR) recommend embedding and enabling research at all levels of radiography practice and education [16]. The European Federation of Radiographer Societies (EFRS) published the European Qualifications Framework (EQF), Level 6 (Bachelor) and Level 7 (Master), which suggests the incorporation of evidence and research as learning outcomes for bachelor degrees [17]. This also provides a benchmark for postgraduate education with numerous learning objectives at the masters level compared to the bachelor level [18]. Despite such policy decisions at organisational level, it is felt that the further development of research in radiography requires changes in attitudes and the implementation of a culture which values, supports and encourages research [5]. With this in mind, various approaches have been implemented to inspire and facilitate radiographers to engage in research. OPTIMAX [19], a multicultural, multidisciplinary residential summer school has enabled many radiographers to initiate a career or part career in research. OPTIMAX is a project that gave students hands on experience of research which optimized radiation dose while preserving image quality in medical imaging . Ward et al [20], demonstrated a successful strategy in increasing the number of people involved in research through mentorship. CoR created FoRRM (Formal Radiography Research Mentoring) as a mentoring scheme to increase research capacity and quality in radiography [21]. Several health professions, such as pathology [22], paediatric nephrology [23], and nursing [24] have adopted mentoring schemes, which have had a positive impact. However, the previous studies lacked comprehensive representation as they focused solely on specific professional groups, and they did not approach the insights from both diagnostic radiographers and therapeutic radiographers who work in both academic and clinical environments. A research strategy has also been developed, with goals that apply to all levels of both the profession and research [16]. The progress has been slow and it does not include radiographers worldwide. So far, no international study has been published about radiographer or therapeutic radiographer barriers and limita-

tions for involvement in research. In addition, many countries have never been included in surveys pertaining to this subject matter.

To gain a better understanding of the challenges faced by diagnostic radiographers and therapeutic radiographers in initiating or enhancing their research activities, there is a need to understand the viewpoints of multiple countries. To date, only a few studies have been published and these are focused on national perspectives, for example: Nordic countries [25], United kingdom [26], Australia [11] and Canada [14]. This paper considers the results of the first international survey that focuses on clinical, managerial and academic radiographers, including diagnostic radiographer and therapeutic radiographer perspectives, on research involvement, barriers to and support mechanisms for research and to discuss solutions.

Methods

A survey was conducted to determine the level of research activity undertaken and perceived challenges experienced by as well as support required for diagnostic radiographers and therapeutic radiographers to conduct research. In this study, we have used an adapted approach of SQUIRE 2.0 guideline [27] to elaborate the method.

Study design and sample

The study population includes an international sample of diagnostic radiographers and therapeutic radiographers from all continents, as well as students across clinical and academic contexts. The survey included radiographers in a variety of different roles such as clinical radiographers, management, education and research. It is worth noting that not all countries require radiographers to be state registered to practice. Consequently, we did not require participants to be state registered and simply relied upon people to complete the survey if they felt they were considered to be a radiographer. This enabled a more inclusive approach to be taken and thus a larger and more representative sample to be included.

Ethics

The ethics committee of the country and university initiating this survey concluded the need for ethical approval as unnecessary. This was due to the fact that no identifying information was collected about respondents as well as no possibility of tracing back the respondents thereby assuring anonymity. In order to minimize negative impacts on survey respondents, it was conducted in accordance with The Helsinki Declaration [28]. Informed consent was implied by completion of the survey by the respondents.

Questionnaire

The survey was undertaken using a web-based questionnaire, the design of which was informed by previous journal papers [14,15,29]. The questionnaire items were generated by the chair of ISRRT's International Academic Network (IAN), and were critically reviewed and revised by IAN committee members for item topic coverage, item wording and face validity. IAN consists of 11 members, all of which have an academic/research background [30]. The final version of the questionnaire was pilot tested with five diagnostic radiographers and therapeutic radiographers, which identified no problems.

The questionnaire consisted of quantitative closed questions, and qualitative open-ended questions. It was divided into three categories: 1) respondent demographics; 2) research experience and interest; 3) perceived barriers and support for conducting research (Table 1). Respondents answering option "other" from the predefined list were required to elaborate on the answer through the open text box.

The questionnaire was available in two ways: 1) it was hosted in *Google Forms* housed on the International Society of Radiographers and Radiological Technologists (ISRRT) homepage [31]; and 2) an identical questionnaire was hosted in *Nettskjema* (an online survey platform). It was necessary to have two versions because some potential responder organizational firewalls prevented the use of Google Forms. Invitation letters were sent via email to ISRRT members and promotional information was published in various places to encourage participation. The questionnaire was active for 4 months, from October 2022 to January 2023. The data obtained from Google forms and Nettskjema were automatically collected in an Excel spreadsheet and then imported to SPSS (version 28, 2021) for analysis. The qualitative data is not included in this paper; it is analysis will be explained within a subsequent paper which will focus specifically on information.

Data analysis

The distribution of percentage was calculated for categorical variables. A chi-square of association was performed to investigate the differences between categorical variables. A logistic regression analysis was performed to investigate the odds of participating in research depending on the demographics characteristics (age, location of respondents, highest education, working place, position, category of research projects the respondents are involved in**,** job experience and acted as research supervisor/mentor).

Logistic regression is employed to calculate the odds ratio (OR), when there are multiple variables being analyzed simultaneously. In practical terms, a large odds ratio suggests that the chance of a specific group experiencing the outcome is significantly higher than that of the reference group [32].

The position of therapeutic radiographers was used as a reference for regression analysis, as literature indicates several papers discussing the awareness of therapeutic radiographerś participation in research [33–38].

A p-value of <0.05 was considered as statistically significant for logistic regression analysis and chi-square .

Table 1
Questionnaire.

Questions category	Questions
Demographics	• What is your age? • Which region do you work in? • What type of working place do you have? • What kind of position do you have? • What are your education/degrees completed? • How many years of job experience as an educator, researcher, radiographer (including delivery of therapeutic treatment and treatment planning) do you have?
Research experience and interest	• Do you have any experience conducting research (beyond experience as a student / other than within a university qualification)? ○ How many years have you been involved in conducting research: ○ Please indicate the category of research projects you are involved in: (you may select more than one answer) • Please explain in 1-2 sentences the nature of the research you hope to be involved with • What is your research field experience/interest? • What kind of research project interests you? Please indicate both qualitative and/or quantitative, as well as the modality of interest.
Barriers and support	• Have you ever acted as a higher degree research supervisor, researcher, or research mentor before (e.g., supervision of a master's degree student and/or a PhD-student, etc.)? ○ If you answer 'yes' to the above question, are you available to assist to support novice researchers (to answer questions related to the preparation of project proposal, ethical approval application, project design, funding application, etc)? • Are you currently involved in a research project? ○ If no, are you hoping to be involved in research in the future? ■ If you answer yes, how soon do you hope to be involved in research? ○ And if you select yes, please choose the category of research projects • What is the main limitation of performing research in your University/Hospital? • What kind of supports/resources do you need to perform research or increase your research activity? • Are there instruments or specific tools available in your university or hospital for you to perform research (e.g., phantoms, ionization chamber, etc.)? • Are student radiographers involved in your research projects? ○ If no, could you explain why? • What kind of research training do you need to help you get started / get more involved in research? • Please feel free to add any other comments:

Results

Sample characteristics

The total number of respondents was 420. The demographic characteristics are included in Table 2. A response rate could not be calculated as we do not know how many diagnostic and therapeutic radiographers there are in the world.

Demographic details

Most of the respondents were located in Asia/Australasia (54%), were employed in a clinical setting (56%) and worked as a diagnostic/therapeutic radiographers (49.5%). The Asia/Australasia group included Australia, Japan, India, United Arab Emirates, new Zealand, Sri Lanka, Indonesia, Middle East, Palestine and Malaysia.

Slightly more than eighty seven percent (87.4%) had a master's degree or lower, and more than half had greater than 10 years working experience (59.5%). Regarding category of research projects, 69.5% worked within more than one field, followed by Medical Imaging/Diagnostic (14.8%). In total, 59.3% of respondents had not acted as a research supervisor/mentor.

Respondents with 10 or more years of work experience were more actively involved in research compared to those with less than 10 years experience.

It was observed that the place of work showed a significant difference ($p<0.001$) regarding research involvement. It is noteworthy that the majority (72.2%) of respondents who worked in an academic environment (e.g. Universities, Colleges) were involved in research, while professionals in clinical practice were less involved (24.1%). A significant difference in research involvement ($p<0.001$) exists between those $\geq$30 years old, compared to younger respondents.

Most respondents were diagnostic radiographers (n=208) and 79.3% of these were not involved in research. Additionally, two professional groupings showed higher involvement in research: those who worked as researchers and teachers (89.8%), and the ones who only worked as researchers (88.9%). The relationship between employment role and research involvement was statistically significant ($p<0.001$).

The relationship between the type of research and current research involvement was observed as statistically significant ($p<0.001$).

The results showed a significant correlation between educational level and current research involvement ($p<0.001$), in

Table 2
Current involvement in a research project in relation to demographic characteristics.

Age	Are you currently involved in a research project?				
	Yes	No	Total	% Total	p-value
<30	26	74	100	23.8	0.001
	26.0%	74.0%	100.0%		
≥30	145	175	320	76.2	
	45.3%	54.7%	100.0%		
Working place					
Academy	57	22	79	19.1	<0.001
	72.2%	27.8%	100.0%		
Clinical Practice	56	176	232	56.0	
	24.1%	75.9%	100.0%		
Academy and Clinical Practice	55	45	100	24.2	
	55.0%	45.0%	100.0%		
Industry	1	2	3	0.7	
	33.3%	66.7%	100.0%		
Position					
Student	2	2	4	0.9	<0.001
	50.0%	50.0%	100.0%		
Diagnostic Radiographer	43	165	208	49.5	
	20.7%	79.3%	100.0%		
Educator	41	45	86	20.5	
	47.7%	52.3%	100.0%		
Researcher	24	3	27	6.4	
	88.9%	11.1%	100.0%		
Educator and Researcher	44	5	49	11.7	
	89.8%	10.2%	100.0%		
Therapeutic radiographer	17	29	46	11.0	
	37.0%	63.0%	100%		
Category of research projects involved in					
Medical Imaging/Diagnostic	10	20	30	14.8	0.001
	33.3%	66.7%	100.0%		
Radiation therapy treatments	5	2	7	3.4	
	71.4%	28.6%	100.0%		
Nuclear Medicine	1	1	2	1.0	
	50.0%	50.0%	100.0%		
Education	4	2	6	3.0	
	66.7%	33.3%	100.0%		
Professional practice	1	0	1	0.5	
	100.0%	0.0%	100.0%		
Clinical study	7	5	12	5.9	
	58.3%	41.7%	100.0%		
More than one modality	105	36	141	69.5	
74.5%	25.5%	100.0%			
Other	1	1	2	1.0	
	50.0%	50.0%	100.0%		
Dosimetry	1	1	2	1.0	
	50.0%	50.0%	100.0%		
Highest education					
Higher than Master degree	41	12	53	12.6	
	77.4%	22.6%	100.0%		<0.001
Master degree or Lower than Master	130	237	367	87.4	
	35.4%	64.6%	100.0%		
Location of survey respondents					
Asia/Australasia	96	131	227	54.0	0.008
	42.3%	57.7%	100.0%		
Africa	17	18	35	8.3	
	48.6%	51.4%	100.0%		
Europe	39	88	127	30.2	

(*continued on next page*)

Table 2 (*continued*)

Age	Are you currently involved in a research project?				
	Yes	No	Total	% Total	p-value
	30.7%	69.3%	100.0%		
Americas	19	12	31	8.1	
	61.3%	38.7%	100.0%		
Job experience					
<10 years	55	115	170	40.5	0.005
	32.4%	67.6%	100.0%		
>10 years	116	134	250	59.5	
	46.4%	53.6%	100.0%		
Act as a research supervisor/mentor					
Yes	89	82	171	40.7	
	52.0%	48.0%	100.0%		<0,001
No	27	222	249	59.3	
	10.8%	89.2%	100.0%		

addition to years of work experience ($p<0.001$). The geographical location of the respondents ($p=0.008$) indicated a significant impact, on terms of research involvement. The respondents from the Americas (North and South America) showed a higher research involvement (61.3%). In contrast, respondents from Europe demonstrated a higher percentage of non-involvement in research (69.3%). Regarding the involvement of the supervisor and mentor in research, a significant difference ($p<0.001$) between individuals involved in research and those who assumed roles as research supervisors/mentors was noted.

Overall, the group most involved in research was the group with: a) 10 years or more of working experience, b) worked in an academic environment, c) ≥30 years old, d) worked as researchers and teachers and e) the group of respondents located in Americas.

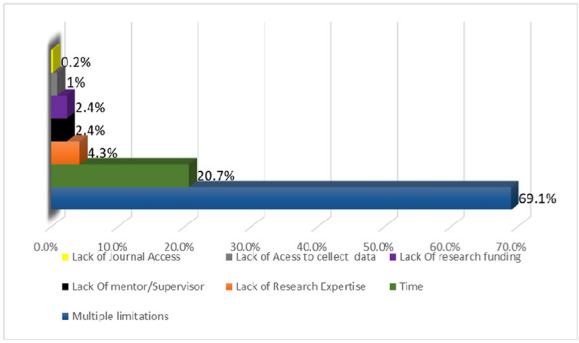

Figure 1. The limitation to perform research projects by respondents. [a]The association of more than one reason to perform research project was considered as" multiple limitations" (Eg. Time, lack of research funding and lack of mentorship)

Research Experience and Interest

The significance levels and odds ratios (OR) for the association between those currently involved in a research project in relation to the demographic characteristics are shown in Table 3.

The results of logistic regression indicate that respondents who were researchers or teachers had (OR=13.64 and OR=15.01) higher current involvement, respectively, compared to therapeutic radiographers. Respondents who were ≥30 years old, from Americas working in an academic setting demonstrated at least twice as high OR (2.35, 2.16 and 2.12, respectively) compared to the other 'groups' used in this analysis for current involvement in a research project. Regarding education level, respondents who held a doctorate were 6.22 more likely to be involved in a research project than those with a master degree or lower. Respondents with 10 or more years of working experience demonstrated 1.8 times higher likelihood of being involved in a current research project compared to those with less than 10 years of working experience.

Barriers and support

There are multiple reasons that inhibit respondents from conducting research (Figure 1). A combination of various barriers, such as lack of time, lack of research expertise or lack of mentorship were the most common ones. Respondents considered the lack of time (20.7%) as a limiting factor for research involvement also.

Regarding the kind of support to perform research, respondents indicated they needed more time to do research (15.5%) as a means to increase research involvement or enhance research activities (Figure 2). There was a higher frequency of answers (69.3%) related to the combination of multiple subjects (time, research mentor, research funding or access to collect patient data) for support, rather than relying on a single demand.

In terms of category of research involvement in the future (see Figure 3), a large number of respondents indicated they were involved in more than one imaging modality (72.4%). The second most common research category to be involved was Medical Imaging/Diagnostic (16.4%).

Table 3
Significance levels and odds ratios (OR) for the probability of being involved in a research project in relation to the demographic characteristics.

GROUP	Currently involved in a research project	
	Sig*.	OR**
Age		
<30	Ref	0.35
≥30	0.001	2.35
Location of survey respondents		
Asia/Australasia	Ref	
Africa	0.486	1.28
Europe	0.032	0.60
America	0.050	2.16
Position		
Therapeutic radiographer	Ref	
Diagnostic Radiographer	0.021	0.44
Educator	0.238	1.55
Researcher	<0.001	13.64
Educator and Researcher	<0.001	15.01
Working place		
Academy and Clinical Practice	Ref	
Academy	0.019	2.12
Clinical Practice	<0.001	0.26
education/degrees completed		
Master degree or Lower	Ref	0.54
Higher than Master degree	<0,001	6.22
Job experience		
<10	Ref	
≥10	0,004	1.81

* Significance
** Odds Ratio

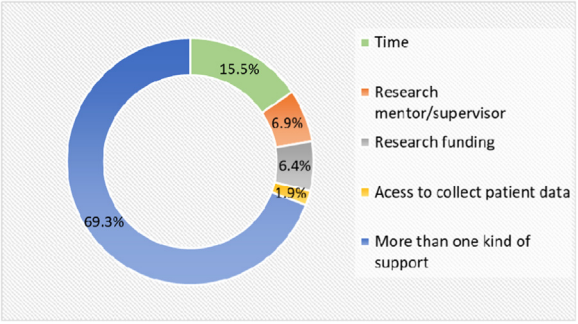

Figure 2. Kind of support required to perform research projects.

DISCUSSION

This international survey has identified the diagnostic radiographers and therapeutic radiographers' involvement and experience in research across the world, their research experience and interests, as well as the perceived barriers and support that is needed. Evaluation of occupational roles (e.g. teacher, clinical) demonstrated a statistically significant correlation between research involvement, and more extensive work experience. In line with other studies [25,39], our survey showed that diagnostic radiographers and therapeutic radiographers with longer work experience were more likely to be involved in research than those with less experience.

The primary focus of a radiographer's role continues to revolve around clinical responsibilities, as well as roles related to teaching and education [40]. Interestingly, the majority of diagnostic radiographers and therapeutic radiographers with doctoral degrees were employed in academic activities, while only a small number held clinical positions. Individuals exclusively involved in clinical practice exhibit nearly an 80% lower level of research involvement compared to those balancing academic and clinical practice. This finding underscores the imperative for integrating clinical practice with research involvement.

Radiography is a practically orientated specialty integrating evidence-based research to improve patient outcomes [41,42]. The clinical radiographer may participate in diverse research activities, extending beyond data collection tasks as reported by Saukko et al. [25]. According to Bolejko et al [15], support from colleagues and other professionals, as well as self-esteem in research skills, are important factors that enable diagnostic radiographers to actively participate in research. Furthermore, the combination of autonomy in research [15] (the freedom and independence to initiate and participate in research projects), mentor support [20] (positive reinforcement and guidance from mentors can contribute to a sense of competence and validation), successful project completion [43] (accomplishing milestones in the research process validates the individual's knowledge and skills,), and confidence in knowledge and skills collectively contributes to an improved sense of self-

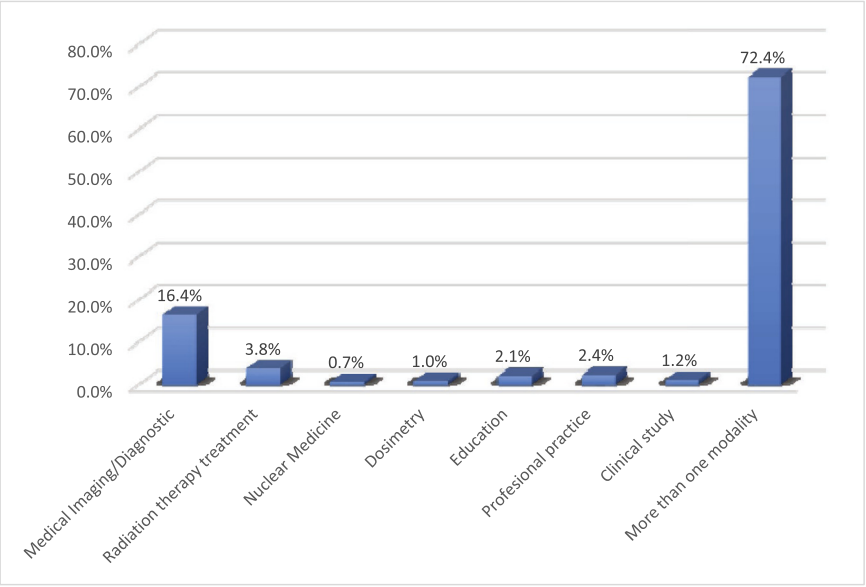

Figure 3. Category of the research respondents wished to be involved with in the future.

esteem in the context of research. Additionally, having a positive self-perception of one's research skills can boost confidence and motivation, leading to increased involvement in research activities among diagnostic radiographers [15].

Our study found multifaceted reasons (69.1%) which limit diagnostic and therapeutic radiographers involvement in research. A combination of factors needs to be addressed to improve the current situation. These results suggest that to improve involvement in research requires multiple interconnected issues beyond the individual elements of time and expertise.

In terms of the current research involvement associated with the position, it was observed that respondents who acted as researchers, or who were involved in education and research, exhibit higher levels of involvement compared to therapeutic radiographers. Despite the large number of publications related to the involvement of therapeutic radiographers [12,34,35,37,38,44] in research, no statistically significant difference was found when compared to the position of diagnostic radiographers in this study. This could be attributed to the fact that both diagnostic radiographers and therapeutic radiographers respondents primarily work in clinical practice. Conversely, respondents who worked in academia or had a combination of academic and clinical practice roles demonstrated a greater involvement in research (Table 2).

Respondents who hold a doctorate qualification are more likely to be involved in research than those who hold a master or bachelor degree. Anderson et al. [45], suggest that in radiology departments, it has been a prevailing tradition for radiographers to abstain from pursuing doctoral studies and engaging in research activities. In the study conducted by Chau et al. [11]], a significant number of radiography practitioners expressed that they did not have any intentions to become involved in postgraduate research in the future. One of the reasons cited for this decision was a lack of interest or motivation [11]. Interestingly, Mubuuke et al. [46] indicate several factors influencing diagnostic radiographers to embark in postgraduate education. These factors include personal and professional development, the desire for new challenges, and the quest for professional satisfaction [45]. Notably, research is not mentioned as a motivating factor.

Our study revealed a substantial level of interest among respondents to participate in research, across various imaging modalities (72.4%). Moreover, the results of the current study demonstrated that the survey respondents are highly motivated and not limited to any specific area (Figure 3). Moran and Davis [14] also identified higher interest and involvement in research for therapeutic radiographers when compared with diagnostic radiographers.

Challenges and barriers

Time was identified as one of the most common challenges and limitations faced by respondents to becoming involved with research, accounting for 20.7% of those reported. This finding aligns with previous studies that had also identified time as a critical limiting factor to conducting research [11,33,38]. Based on these results, future research should investigate ways in which time can be made available to allow radiographers to conduct research.

Mentorship plays a crucial role in supporting novice, early- and mid-career researchers by providing valuable guidance and support in building research capacity within the clinical workforce [20]. Mentors can help generate research ideas, offer advice and encouragement throughout the research process, and assist in the final publication of work [47]. Our findings indicate a high number of respondents (n=222) never had a su-

Table 4
Factors which influence research quality, volume, and value.

Hospital and university
Effective leadership
Organisational culture which supports and values research
A strategy for research with an associated implementation plan
Ideally, a singular research focus with a clear aim(s)
Research-capable staff in the research field
Availability of additional expertise relevant to the research (e.g. medical statistician)
Succession planning, including: • Translation of research into teaching • Formal mentorship for early, mid, and late career researchers
Adequate time allocation for (some) staff to do research
Team-based research; ideally multi-professional team-based research
Adequate level of research grant capture
Adequate physical resource
Relevant and well-structured research questions
Acceptable ethical standards
Formal mechanism to internally assess research along with a benchmark which should be reached
Formal mechanism to translate research outcomes into clinical practice
Effective dissemination strategy, which includes publishing papers in a range of good quality relevant journals; each paper would have its own publication strategy
University only
Formal mechanism to translate research outcomes into educational programmes
Suitable numbers of Post Graduate Research Students (e.g. PhD), with completions occurring in the right timeframe

pervisor / mentor. Unsurprisingly, a lack of mentor/supervisor was mentioned as a barrier by some respondents (6.9%). It is imperative to promote research mentorship strategies, even in cases where a formal leader or supervisor may be lacking. In such cases, establishing partnerships with universities and other external organizations may be a positive strategy in the field of health. The UK College of Radiographers offers a formal way to support future researchers [21]. One effective approach is to establish partnerships with external organizations, particularly with research active staff in universities, as this has shown positive outcomes [48]. By fostering these collaborations, individuals can benefit from mentorship and guidance from experienced researchers, enhancing their research involvement and capabilities.

In terms of implementing a research culture, it can occur at diverse education levels including bachelor / master degree and doctoral. For students, several challenges were recognized as barriers to engaging in research. These challenges included limited local opportunities for research, a dearth of topic ideas, disinterest in research, and a lack of knowledge regarding research methodologies [44].

Factors which stimulate and improve research productivity, quality and sustainability

In terms of solutions, some factors may stimulate and improve research activity for diagnostic radiographers and therapeutic radiographers who work in academic or clinical settings. Often, within radiography, suggestions for stimulating and improving research are focused on an individual's level and include attaining research training (e.g., PhD) and the provision of mentorship [26,49]. By contrast, in 2016, Hogg [50] considered important factors across and within organisations that are needed to deliver acceptable research quality and quantity that would have value to radiography practice. These factors have been extracted from Hogg's conference paper and are highlighted in Table 4. Some factors apply to universities, others to hospitals and some to both. It is worth noting Hogg's conference paper was based on his experiences of running a large multi-professional Research Centre and external national audit saw the Centre's national rank improve substantially because of it is working practices. Sibusisoś [51] study pointed out some solutions and how research performance can help to drive professional development and growth. Hogg's [50] experiences and suggestions align well with Sibusiso's [51] work.

In accordance with the recent guidelines for sound research practices outlined by the National Health Service in the UK [52], Hogg [50] suggested that research should be part of organisational aims and be led by somebody with proven leadership skills who has credibility in the research area. Futhermore, organisational culture should be fully supportive of the research to be undertaken [53,54]. A research strategy and implementation plan, ideally focused on one area or research priority [51] (e.g. diagnosis of breast cancer using mammography), are essential and together they would outline matters such as mission, vision, focus, goals and how these would be achieved, to what standard and in what timeframe [52]. This strategy allied with the M.V.F.G.A.T (M: Mission, V: Vision, F: Focus, G: goals, A: achievement, T: Timeframe) principle may give a direction for research involvement improvement [50].

Ideally, staff should work in multi-professional teams and as needed, staff with specialist skills may be co-opted into research teams (e.g. medical statistician) [39,55] and Staff who perform research must be allocated time to devote to the agreed research

ambitions [50,56]. Hogg [50] continues to suggest that succession planning is essential, enabling sustainability of the research area over time. This will include translating research principles and research findings into under- and post-graduate curricula, continuing staff development and formal mentorship schemes for early-, mid- and late-career researchers [57]. Research costs money, for staff time and physical resource (e.g. CT scanner), therefore bidding for external grant funding must be successful to underwrite research costs year on year [56,58].

Research should meet ethical expectations and be of value to the clinical and academic radiographic community [59]. Research outputs must meet quality standards and one way of doing this is by implementing an internal organisational review mechanism, in which journal papers must be read and scored for quality by senior staff, with feedback being provided to the staff [54,56,60]. Once research outcomes have been achieved it is important that articles are published into a wide range of relevant and respected journals, to achieve this each article will have it is own publication strategy [60]. Research outcomes should be translated into educational or clinical practice, to achieve this, suitable strategies need implementing [61]. Adequate numbers of externally funded Post Graduate Research Students (e.g. PhD) should work alongside [51] and be supervised by staff within the research area – this enables opportunities for development of new researchers and it also enables larger amounts of time to be devoted to the research itself.

Based on the results of our survey and potential solutions indicated in the literature, we feel it is reasonable that radiographic community at large should promote solutions and actions to help stimulate and enhance diagnostic and therapeutic radiographer research involvement. Implementing some or all of Hogg's [50] and Sibusisoś [51] proposals is likely to help achieve this ambition.

Our study has limitations that should be taken into consideration. Firstly, our sample may have limited representation from individuals working in the fields of nuclear medicine and radiologic industry. Secondly, the low number of respondents from African and Americas may limit the findings to individuals who work in these regions. These limitations highlight potential areas for further research, aiming to include a more diverse range of participants, including individuals working in nuclear medicine, radiologic industry and African and Americas.

Conclusion

Our study has identified important findings, regarding the current involvement of diagnostic and therapeutic radiographers in research. Low levels of radiographers are currently involved in research and several barriers exist in allowing them to do so. Further changes to working practices and culture are needed to improve the situation, however further research is needed to help understand how the barriers might be overcome. Research mentorship is likely to play an important part of facilitating radiographers to conduct research, which should likely be accompanied by workplace changes, such as allocating time to do research. Similarly, research networks / collaborations are likely to have positive enabling benefits and establishing these for novice and early-career researchers is important. Our study provides a platform on which future efforts can be created to help increase research productivity amongst radiographers. In addition, there is a need for necessary education and training in order to support them as they move forward to become more research active.

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