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A tale of three programmes: subspecialty and employment differences between residents in radiology

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INTRODUCTION

Previous surveys in the United Kingdom⁽¹⁾ and the United States⁽²⁾ have shown that residents' motivations and perceptions towards the various radiology subspecialties affect the ability of departments to recruit and retain staff, particularly in areas such as breast and paediatric imaging. It is also known, albeit anecdotally, that restructured hospitals in Singapore face similar challenges in recruiting residency graduates, with many positions in perceived unpopular radiology subspecialties left chronically unfilled.

The purpose of this study is to survey radiology residents and residency graduates in Singapore to find out the factors influencing their subspecialisation choices and institution of employment. We hope that this data can be used by employers to reflect on their policies, practices and culture in order to recruit the best talent for their institution. This information may also be used by diagnostic radiology residency programmes to modify training in order to make unpopular subspecialties more desirable. Training programmes from other specialties and in other countries may find this survey useful to replicate in their own institutions.

To provide some context: Singapore is a small city-state of about 720 square kilometres in South-east Asia, with a population of approximately 5.7 million in 2019.⁽³⁾ As of 31 December 2018, there were 368 diagnostic radiologists (269 in the public sector and 99 in the private sector) and 29 nuclear medicine physicians (18 in the public sector and 11 in the private sector) on the register of specialists,⁽⁴⁾ giving rise to a diagnostic radiologist-to-population ratio of 1:15489.

Radiology training in Singapore has recently been refashioned from a British-modelled system to the residency training programme similar to that in the United States. There are three diagnostic radiology residency programmes in Singapore, all accredited by the Accreditation Council for Graduate Medical Education International (ACGME-I). In total, 20 to 22 residents are

accepted into training programs nationwide annually, although this number has been gradually climbing since the inaugural intake in 2011 to meet the growing demand for radiologists.

The programs are uniformly five years in duration, with core rotations in the first four years and the final year (R5) being a mandatory ‘fellowship’ year. In R5, residents can tailor their rotations (subspecialty and institution) to cater to their professional interests, although a maximum of 2 subspecialty focuses is preferred. This is to allow trainees to gain the requisite experience to practice independently as subspecialists on graduation. The exception is nuclear medicine, which is a separate subspecialty track which begins in R5 and lasts two and a half years. Nuclear medicine trainees complete their training one and half years later than their peers in other radiology subspecialties. Residents completing this will be dual-accredited in diagnostic radiology and nuclear medicine.

Each programme is managed by one of three Singapore public healthcare clusters. These are the National Healthcare Group (NHG), National University Health System (NUHS) and SingHealth (SH). The clusters differ in their portfolio of restructured hospitals and range of specialty outpatient centres, which translates to a different number of site exposures in each residency programme as depicted in Fig. 1. Of note, NHG residents train in SH institutions for paediatric radiology, neuroradiology and nuclear medicine, and NUH is the only hospital in Singapore with the complete suite of radiology subspecialties under one roof. As expected, there are inter-residency differences in longitudinal exposure to radiology subspecialties.

METHODS

An Institutional Review Board review was not required. An anonymous online survey via Google Forms was administered by email link to all Singapore radiology residents as well as radiology

residency graduates. The survey was conducted from October 2019 to December 2019. Participation was voluntary with no incentive offered. Fisher's exact tests were carried out to evaluate the difference among different institutions, gender and seniority with 2-sided significance level of 0.05. Results were analysed using R 3.6.2 (www.r-project.org). Calculations were checked using an online statistical calculator based on R (<https://astatsa.com>, Navendu Vasavada, 2016).

RESULTS

There were 133 respondents, out of a population of 208 potential responders (response rate 63.9%) consisting 45 females (33.8% of total responders) and 88 males (66.2%). There was no statistically significant difference in response rate between males and females. 59 were junior residents (44.4%), 37 were senior residents (27.8%), and 37 were specialists (27.8%).

Analysis was performed according to residency program (and healthcare cluster), gender and seniority. Figs. 2–7 show the results in graphical form.

The overall top three most popular subspecialties were abdominal imaging, neuroradiology and musculoskeletal imaging. The top three overall most unpopular were paediatric imaging, oncologic imaging and cardiac radiology. Statistically significant differences were seen between residency programs for subspecialty interests in neuroradiology ($p < 0.0001$), paediatric radiology ($p = 0.0030$) and head and neck radiology ($p = 0.0321$).

The top three most popular subspecialties for males were abdominal imaging, interventional radiology and musculoskeletal imaging while the top three most popular for females were abdominal imaging, breast imaging and neuroradiology. Statistically significant differences were seen between genders for subspecialty interests in breast imaging ($p = 0.0021$) and interventional radiology ($p = 0.0003$).

The top three most popular subspecialties for both junior and senior residents were neuroradiology, abdominal imaging and musculoskeletal radiology, while the top three most popular subspecialties for specialists were abdominal radiology, interventional radiology and musculoskeletal radiology. No statistically significant difference was found amongst respondents of different seniority.

Factors influencing choice of subspecialty and institution of employment were divided into two groups: those which influenced to a “great degree” versus all other choices including “moderate degree”, “small degree” and “not at all”. This choice of analysis was made to separate only factors which impacted respondents the most. We found that the overall top three most important factors influencing choice of subspecialty and institution of employment to a great degree were “Interest in subject material”, “Working atmosphere”, and “Personal affinity/talent”. Statistically significant differences were found between residency programmes in “Residency training and exposure” ($p = 0.0240$), “Quality of consultants” ($p = 0.0010$), “Support by consultants” ($p = 0.0227$), and “Job flexibility” ($p = 0.0138$). No statistically significant difference was found amongst respondents of different gender or seniority.

DISCUSSION

We note that the most popular subspecialties in Singapore are similar to multiple publications from the United Kingdom,⁽¹⁾ United States,^(2,5,6) Canada⁽⁷⁾ and Saudi Arabia⁽⁸⁾ where abdominal imaging, neuroradiology, musculoskeletal radiology and interventional radiology are consistently featured in the top four subspecialties in their surveys. The most unpopular subspecialties in these studies are also similar to other studies where cardiac imaging, paediatric radiology and oncologic imaging are less favoured.

Varying exposure during residency may be a key contributing factor to differences in interest amongst subspecialties. Out of 48 months of core rotations in all Singapore residency programs, only up to 3.5 months are assigned to paediatric radiology. This contrasts with 6 months for other core rotations like musculoskeletal radiology and abdominal imaging. In addition, there are only two hospitals with paediatric radiology subspecialty services (National University Hospital and KK Women's and Children's Hospital) and only one specialty centre with a dedicated oncologic imaging subspecialty service, the National Cancer Centre. Cardiac imaging is subsumed under cardiothoracic imaging rotations during residency and there is also limited exposure to cardiac CT, MRI and nuclear cardiology in Singapore. This is largely due to two main factors. Firstly, turf wars between cardiac radiologists and imaging cardiologists have led to differing cardiac imaging workloads. In the majority of Singapore hospitals, there is co-reporting with cardiologists, leading to a relatively low workload for radiologists. Secondly, there are only a few cardiac radiologists in Singapore, which leads to fewer opportunities for residents to be inspired to pursue this subspecialty interest. These add to the perception of the eventual extinction of the cardiac imaging subspecialty, making it a less desirable career choice.

Statistically significant differences between residency programmes in subspecialty interest for neuroradiology, head and neck radiology and paediatric radiology also suggest that exposure is closely tied to interest. Neuroradiology and head and neck radiology are significantly less favoured by NHG residents. NHG residents are only allocated three months of Neuroradiology during their core rotations and receive significantly less longitudinal exposure to brain imaging compared to their peers throughout the rest of their training. Similarly, the head and neck rotation in NHG is only a two-month block, with the daily reporting handled by a dedicated head and neck team. This leads to limited opportunities for NHG residents to develop their interests in these

subspecialties. In the same vein, there is limited in-house exposure to paediatric imaging for both SH and NHG residents, who do a single three month-long paediatric rotation at a specialised women's and children's hospital. On the other hand, NUHS residents are consistently exposed to paediatric imaging studies in their daily and on-call reporting workload even when they are not undergoing their paediatric rotations due to the presence of medical and surgical paediatric departments within NUH. This factor may account for the increased interest for paediatric imaging amongst NUHS residents relative to SH and NHG residents.

Statistically significant differences were seen in subspecialty interest for breast imaging and interventional radiology, with females favouring the former and males favouring the latter. Previous studies^(9,10) have similarly demonstrated the gender differences in interventional radiology, with significantly fewer females choosing the subspecialty due to call work, radiation concerns pertaining to family-planning, and concerns with a male-dominated area.⁽⁹⁾ Findings of clustering of females in mammography are also in line with publications from the US⁽¹¹⁾ and Saudi Arabia.⁽⁸⁾ This was postulated to reflect patient preference for female doctors when assessing breast and gynaecological symptoms, consistent with our patient population in Singapore.

In examining factors influencing choice of subspecialisation and employing institution, it is no surprise that "Interest in subject material" and "Personal affinity/talent" were among the top 3 ranked factors. This mirrors a large meta-analysis of 75 studies and 882209 individuals where "Academic interest" and "Competencies" were the top 2 ranked factors influencing medical students in their subspecialty choice for surveys after the year 2010.⁽¹²⁾

"Working atmosphere" was ranked second and "Support by consultants" ranked fourth amongst factors influencing choice of subspecialisation and employing institution. This indicates the importance of a supportive working environment for our trainees, which in turn impacts their

preferences for future employment. Collegiality, a culture of openness and sharing, fosters an environment of safety, respect and learning.⁽¹³⁾ The converse is true; a toxic workplace of bullying, lack of support, avoidance of responsibility and poor leadership are huge sources of stress and obvious deterrents to would-be employees.⁽¹³⁾ It is interesting to note that active recruitment by consultants/team leader could not compensate for what our trainees experience daily.

Our study is in agreement with others that income does not play a key role in determining one's subspecialty interest.⁽¹²⁾ In our study, "Salary vis a vis workload/calls" was ranked 11 out of 28 factors.

"Support by consultants", "Quality of consultants", "Residency training and exposure", and "Job flexibility" were particularly important to SH residents compared to NHG and NUHS residents. The former three factors may be due to the larger variety of institutions that the SH residents rotate through compared to the other residency programmes, which allows them to work with a greater spectrum of consultants and training environments (see Fig. 1). They may thus have developed a better appreciation of the impact that subspecialty exposure and consultants have on one's interest and place of employment. With regards to "Job flexibility, a subanalysis showed that gender was not the determining factor; out of the 25 SH respondents for whom "Job flexibility" was of great importance, 14 were male and 11 female. Instead, this may be a factor which the younger generation values. Out of the 25 SH respondents, 14 were junior residents, 5 senior residents, and 6 consultants. All 7 NUHS respondents in this same subgroup were also junior residents. This aside, it is important to note that "Job flexibility" was only ranked 15 out of 28 factors.

The results of this study suggest that the structure of a residency programme matters, particularly its mix of hospitals and specialty institutions and their subspecialty capabilities, and

likely strongly influences a residency graduate's subspecialty interest and affinity/talent. Working atmosphere and support by consultants are also critical "soft factors" in a resident's choice of employment and subspecialisation.

Practical immediate measures to shore up interest in under-exposed and low-volume subspecialties include interactive teaching files with in-house assessments and certification. This requires commitment on the part of both residents as well as department leadership as there will likely be tension between clinical duties, education and a need for rest and recovery. Giving residents responsibility to conduct multidisciplinary rounds is also a chance for them to be exposed to challenging cases, understand the clinician's perspective and develop ability and interest. Care must be taken to ensure that this is a positive experience. For example, one should strive to achieve a unified diagnosis between consultants and resident prior to the round rather than correcting the resident during the round itself, and there should be consultants oversight rather than total delegation of responsibility to the resident. Over the long term, residency programs may need to make adjustments to increase the proportion of rotation time allocated to unpopular subspecialties, the failure of which will lead to continuation of the status quo. We anticipate challenges due to infighting between subspecialties over the scarce trainee resource, as well as concerns over non-alignment with international programs and curricula. Hard decisions will have to be made, and change management and communication will be critical to ensuring all stakeholders understand the costs and benefits.

Improving the work environment may seem daunting but it may be simpler than many think. It is often easy to judge an adverse environment to be due to difficult people, but it would be helpful to instead to first seek out what factors may be producing difficult behaviour. Managing workloads and expectations, improving workflows, PACS interfaces, ergonomics and allowing

tailored schedules may be within the realms of modification.⁽¹³⁾ Leaders must be willing to acknowledge the problem, go down to the ground, listen to and engage with staff and trainees to solve them. Most importantly, leaders should be modelling the way and be arbiters of fairness.

This is a study conducted in Singapore and its results may not be generalisable due to differences in culture, healthcare expenditure, geography and debt levels.

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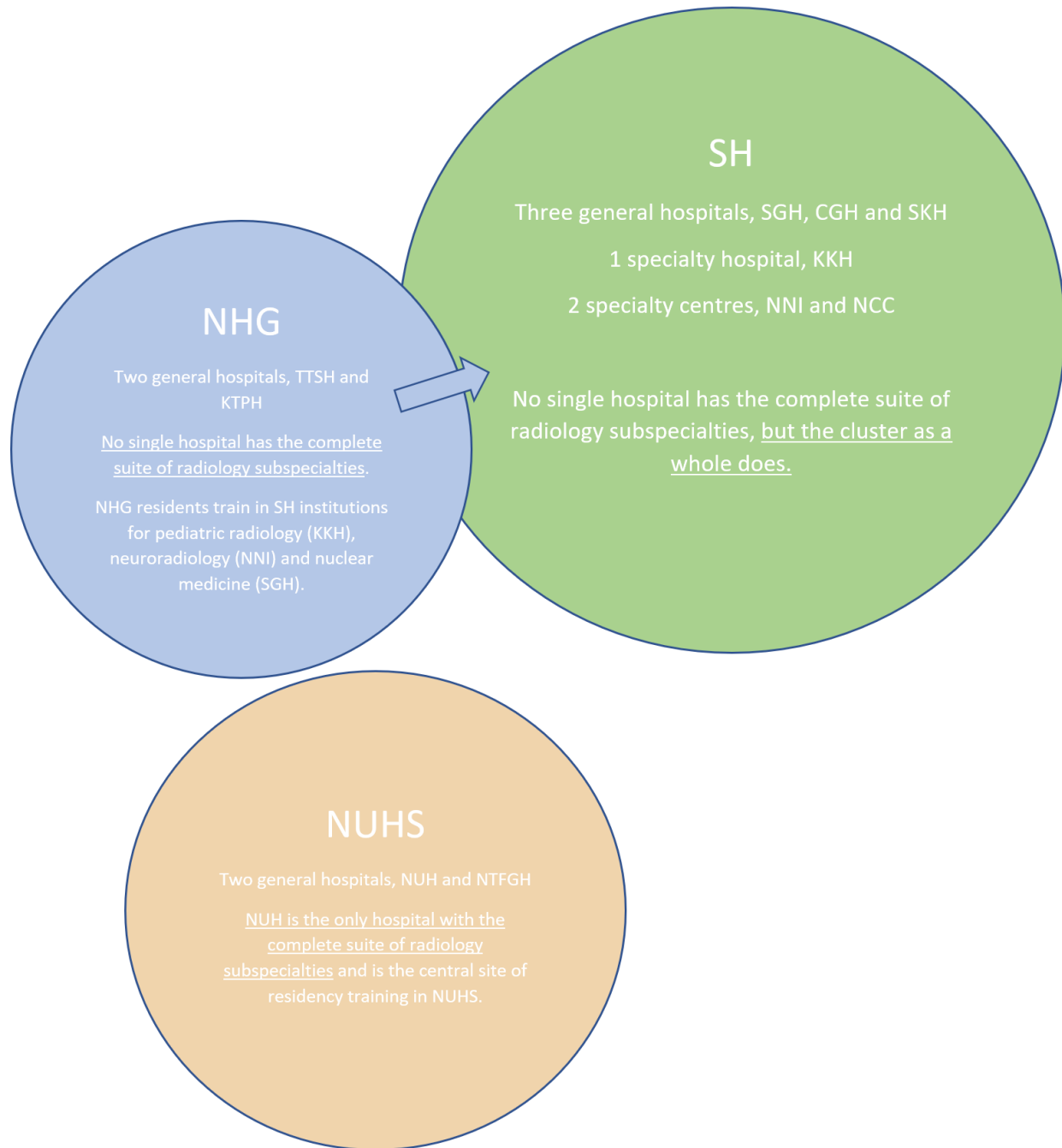
FIGURES

Fig. 1. Overview of Residency Programs managed by Healthcare Clusters in Singapore.

NHG = National Healthcare Group, TTSH = Tan Tock Seck General Hospital, KTPH = Khoo Teck Puat Hospital, SH = SingHealth, SGH = Singapore General Hospital, CGH = Changi General

Hospital, SKH = Sengkang General Hospital, KKH = KK Women's and Children's Hospital, NNI = National Neuroscience Institute, NCC = National Cancer Centre, NUHS = National University Health System, NUH = National University Hospital, NTFGH = Ng Teng Fong General Hospital.

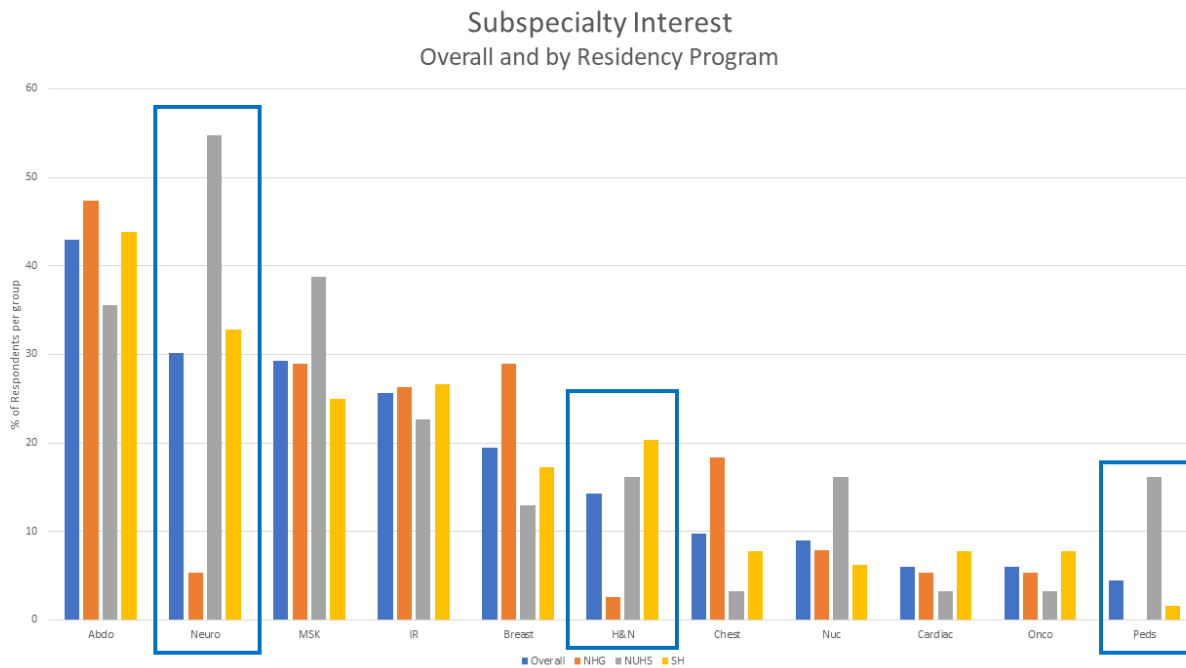


Fig. 2. Analysis of Subspecialty Interest among Respondents, Overall and by Residency Program. Statistically significant differences (highlighted in boxes) were seen between residency programs in subspecialty interests in neuroradiology ($p < 0.0001$), pediatric radiology ($p = 0.0030$) and head and neck radiology ($p = 0.0321$). Abdo= Abdominal imaging, Neuro= Neuroradiology, MSK= Musculoskeletal radiology, IR= Interventional radiology, Breast = Breast imaging, H&N = Head and neck radiology, Chest= Chest imaging, Nuc= Nuclear medicine, Cardiac = Cardiac radiology, Onco= Oncologic imaging, Peds= Pediatric radiology.

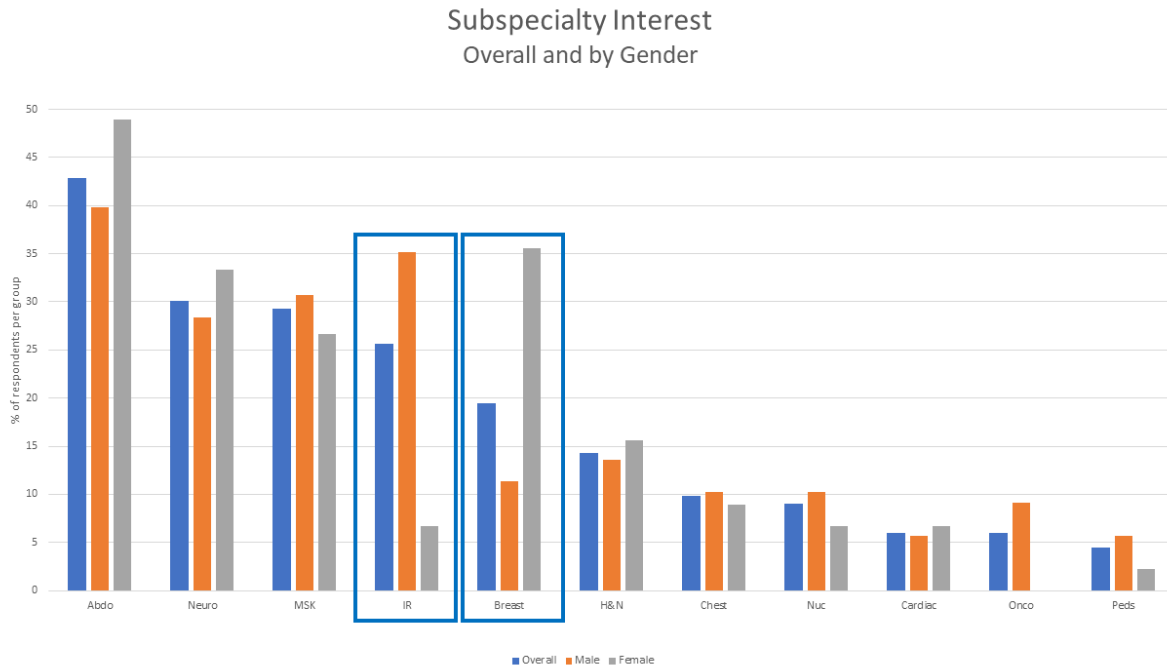


Fig. 3. Analysis of Subspecialty Interest among Respondents, Overall and by Gender.

Statistically significant differences (highlighted in boxes) were seen between genders for subspecialty interests in breast imaging ($p=0.0021$) and interventional radiology ($p=0.0003$).

Abdo= Abdominal imaging, Neuro= Neuroradiology, MSK= Musculoskeletal radiology, IR= Interventional radiology, Breast = Breast imaging, H&N = Head and neck radiology, Chest= Chest imaging, Nuc= Nuclear medicine, Cardiac = Cardiac radiology, Onco= Oncologic imaging, Peds= Pediatric radiology.

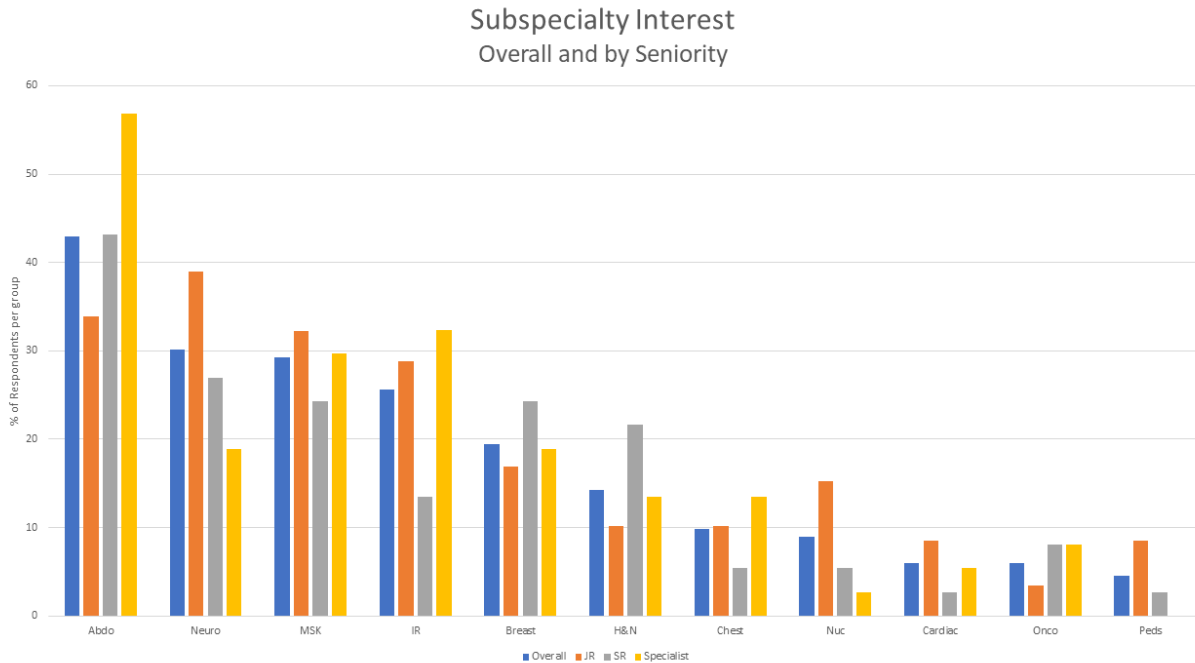


Fig. 4. Analysis of Subspecialty Interest among Respondents, Overall and by Seniority. No statistically significant difference was found amongst respondents of different seniorities. Abdo= Abdominal imaging, Neuro= Neuroradiology, MSK= Musculoskeletal radiology, IR= Interventional radiology, Breast = Breast imaging, H&N = Head and neck radiology, Chest= Chest imaging, Nuc= Nuclear medicine, Cardiac = Cardiac radiology, Onco= Oncologic imaging, Peds= Pediatric radiology.

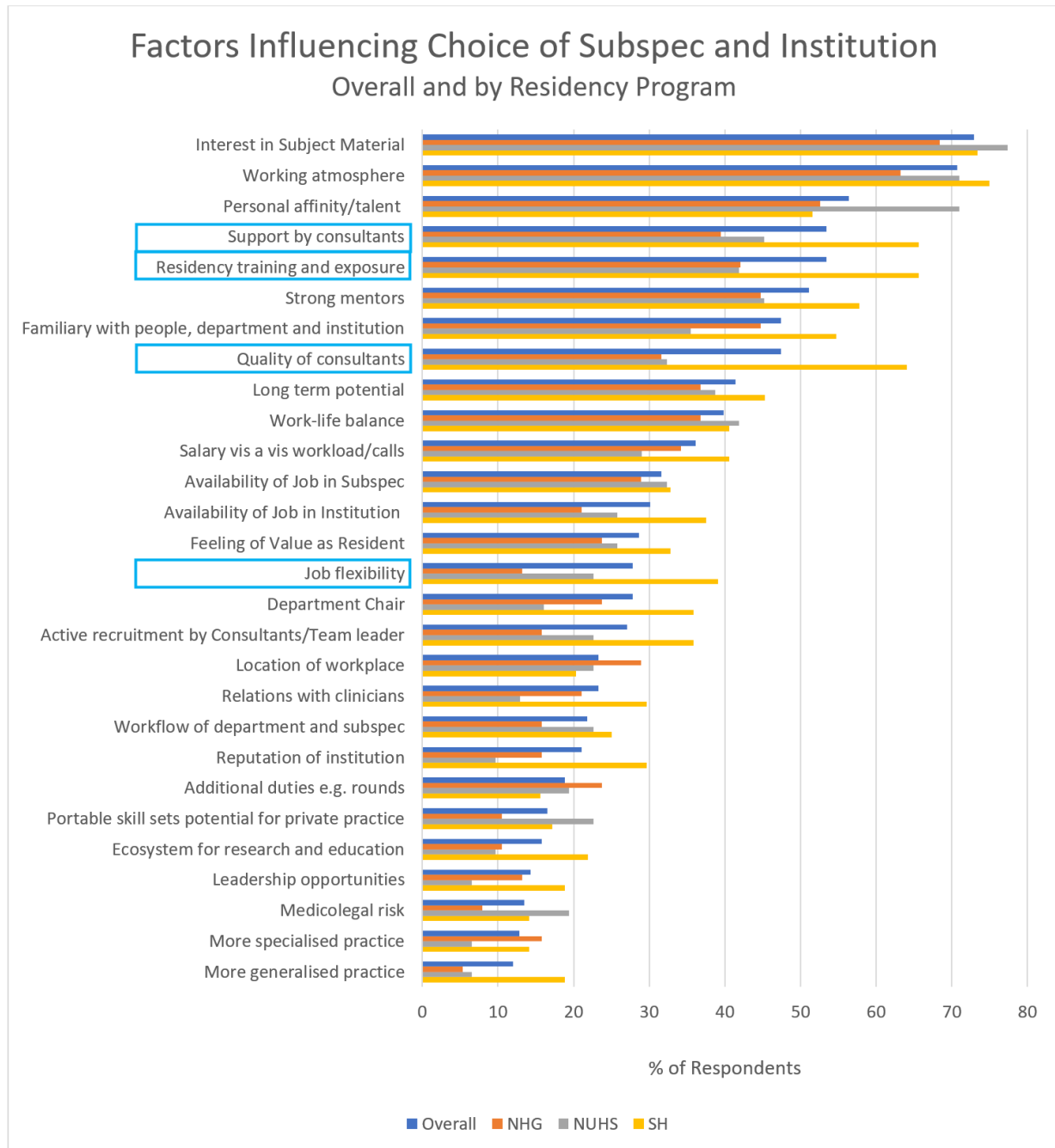


Fig. 5. Analysis of Factors Influencing Choice of Subspecialty and Institution of Employment to a Great Degree, Overall and by Residency Program. Statistically significant differences (highlighted in boxes) were found between residency programs in “Residency training and exposure” ($p=0.0240$), “Quality of consultants” ($p=0.0010$), “Support by consultants” ($p=0.0227$), and “Job flexibility” ($p=0.0138$).

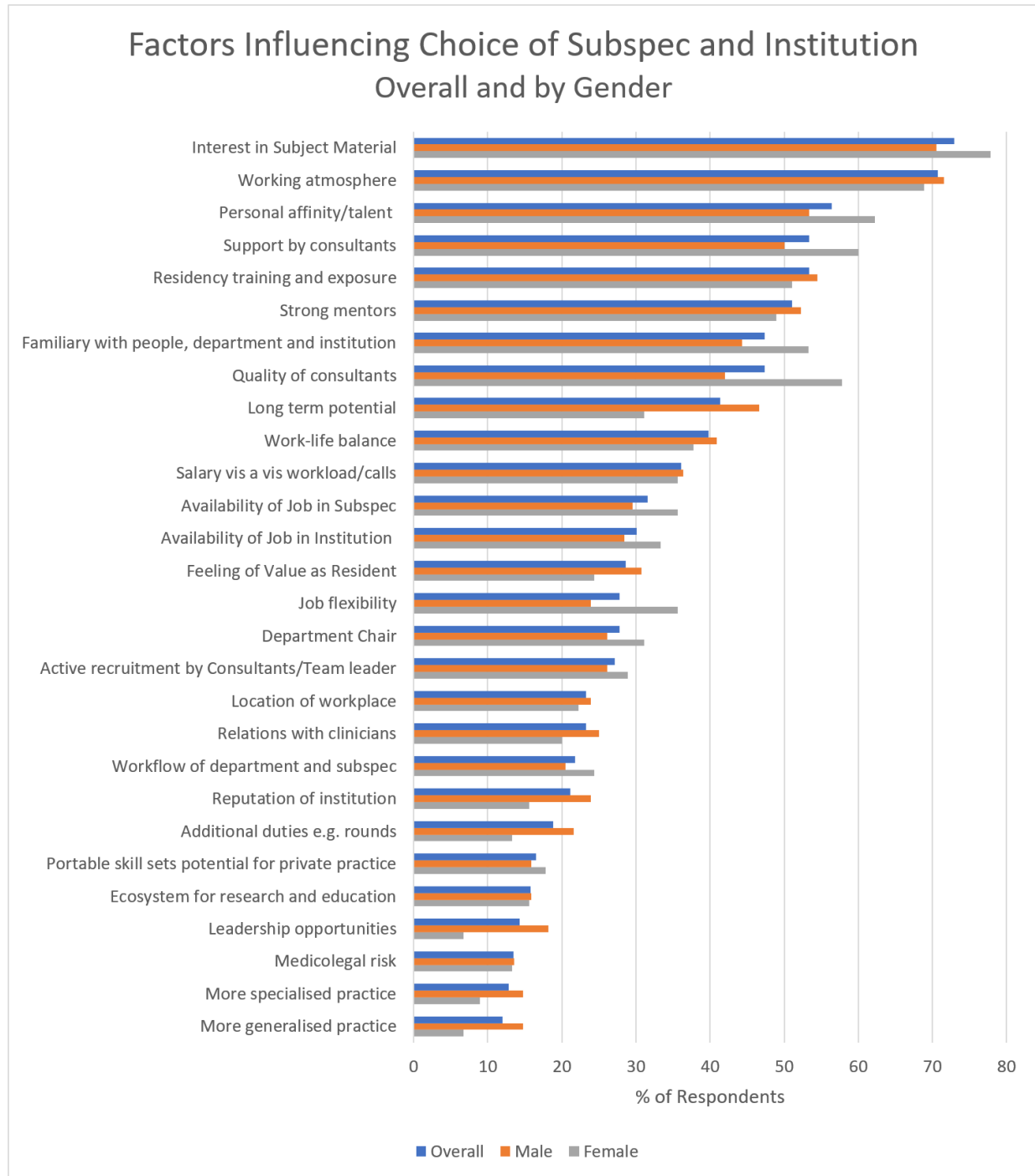


Fig. 6. Analysis of Factors Influencing Choice of Subspecialty and Institution of Employment to a Great Degree, Overall and by Gender. No statistically significant difference was found amongst respondents of different gender.

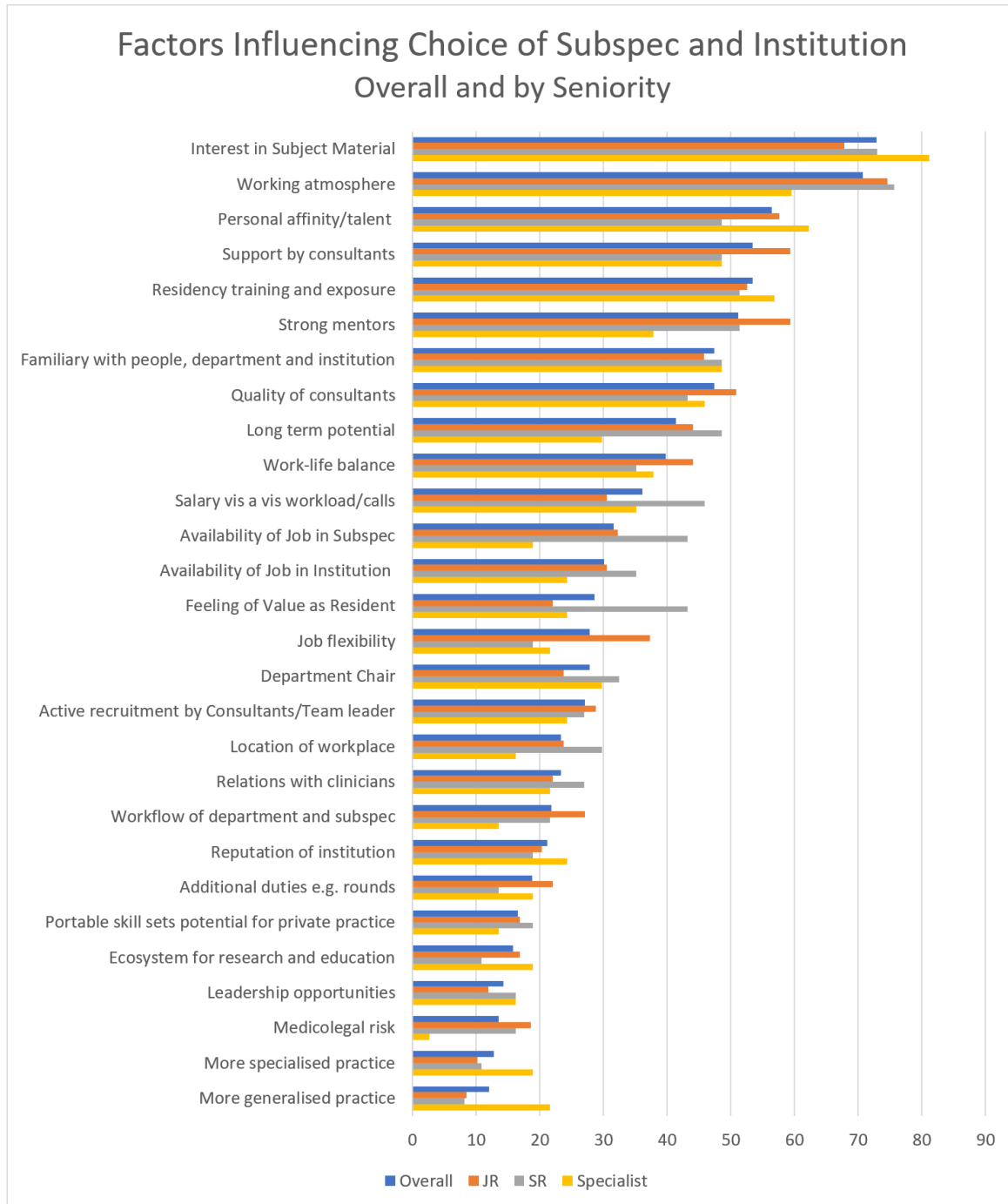


Fig. 7. Analysis of Factors Influencing Choice of Subspecialty and Institution of Employment to a Great Degree, Overall and by Seniority. No statistically significant difference was found amongst respondents of different seniority.