Inequality in Early Career Research in the UK Life Sciences

INEQUALITY IN EARLY CAREER RESEARCH IN THE UK LIFE SCIENCES

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Acknowledgements

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TABLE OF CONTENTS

Executive Summary

This report presents a comprehensive description of early research career demographics and transitions in the life sciences. Using data from the Higher Education Statistical Agency (HESA) and from Biotechnology and Biological Sciences Research Council (BBSRC) doctoral training programmes (DTPs), we examine equality, diversity and inclusion (EDI) characteristics across phases in the doctoral trajectory in life science disciplines, including:

- transition from first to postgraduate research degree, including offers of admission in BBSRC DTPs
- progression through doctoral studies
- employment destination after doctoral graduation.

The main findings from this report confirm, specifically for the life sciences, issues raised by a number of commentators about inequalities in the early research career. These issues have been highlighted for the early research career more generally by the ***Leading Routes*** report and recent open letters to the UK Research and Innovation (UKRI) (Giles et al., 2020; Williams et al., 2019). We find race/ethnic inequalities in the transition from first-degree to postgraduate research degrees in life sciences subjects; these are not accounted for by academic attainment. Black graduates in particular are less likely to be called for interview for or offered a studentship, less likely to successfully complete their PhD and also less likely to transition to postdoctoral academic employment after successfully completing a PhD. These are troubling findings which reinforce the importance of action to achieve a life sciences research workforce which fairly represents UK society.

We identify other inequalities. Women are less likely to progress to a life sciences PhD than men, as are graduates from post-1992 universities and those who have non-graduate parents. Women, Black or Black British graduates and those gaining their PhD from a post-1992 university were all less likely to proceed to a postdoctoral position immediately after their PhD. Additionally, our data show a gender wage gap for life sciences doctoral graduates in their first roles post-PhD.

Our analysis points to the role which university status hierarchies and regional disparities play in shaping opportunities. Life sciences doctoral students are concentrated in a relatively small set of universities, which also tend to have higher numbers of first-degree students from advantaged backgrounds and lower numbers from minority ethnic groups. We found relatively low levels of movement across types of university between undergraduate and doctoral level, suggesting that there are structured pathways which work against graduates from the post-1992 institutions. There is a risk that inequalities are 'baked in' to institutional hierarchies.

Regional mobility is also reduced compared to first-degree level. Most regions are net exporters of graduates into life sciences PhDs, except for London and the East of England which benefit from 'brain gain'. Given the importance of life sciences research and development in the UK economy, this further underlines the need for redistribution of prosperity to the UK's regions.

We found little higher education mobility between levels for life sciences degrees and, therefore, prestigious higher education institutions continued to be richer and whiter at the doctoral degree level. Moreover, regional mobility is also reduced from the first-degree to the postgraduate research degree, although the South East of England and London have a considerable brain gain.

Taken together, we hope these findings will inform and galvanise efforts by the wider higher education life sciences research community, including BBSRC and university/institute based doctoral training programmes, to address early career inequalities.

Recommendations

This report aims first and foremost to describe patterns of progression through the early research career in the life sciences, identifying any apparent inequalities. Nevertheless, the issues we draw out require attention, and we offer the following recommendations to the higher education life sciences research community for addressing them.

1. Create an EDI partnership framework to focus and co-ordinate BBSRC action.

We suggest this should contain at least three elements. First, it should connect to work at UKRI level on EDI issues in research, including UKRI's External advisory group for equality, diversity and inclusion. Second, it should involve engagement with expert groups and the life sciences community. As we note, some of our findings and suggestions repeat those already raised recently in reports and open letters written by academics from minority groups (e.g.: Giles et al., 2020; Williams et al., 2019). Including these academics into the discussion is the first step to understanding persistent race/ethnic inequalities in early research careers and creating the appropriate initiatives to tackle the problem. Third, to be most effective a mechanism is needed to co-ordinate action across BBSRC, DTPs and potentially other partners (other funders, learned societies etc).

2. Establish doctoral studentship schemes in the life sciences for minority ethnic groups, as proposed by the Broken Pipeline Report (Williams et al., 2019).

There are stark race inequalities in access to postgraduate research programmes and funding. First-degree graduates from minority groups are less likely to immediately transition to postgraduate research degrees when compared to White students. Moreover, they are less likely to be invited to an interview and offered a BBSRC studentship. While longer-term actions are necessary, there is a pressing need for positive action to avoid continued inequality. Careful co-ordination is required to ensure that schemes are appropriately designed to fit equalities legislation and to maximise impact within and between research organisations.

3. Introduce targeted postdoctoral schemes for minority ethnic groups.

Individuals who identified as Black or Black British are less likely to have a postdoctoral contract three months after graduation. To address inequalities in the life sciences early research career it will not be sufficient to address access to the PhD, not least because of the time this will take to have an effect. Positive action on postdoctoral positions is also needed.

4. Address structural barriers to opportunity.

Many of the graduates from underrepresented groups complete their undergraduate study in post-1992 universities. Those graduates must be better connected with PhD opportunities, through outreach from DTPs, through expanding the reach of DTPs to include more post-1992 universities, or both. Additionally, BBSRC, UKRI and the Westminster and devolved governments must consider the regional distribution of life science funding and opportunities.

5. Invest in developing understanding of early research career inequalities.

There is a need for better and more joined up data about doctoral study and doctoral students in the life sciences, and about the postdoctoral career inside and outside of academia. Beyond descriptive data, there is a need to better understand the ***processes*** by which inequalities arise. And there is a need to evaluate interventions to understand what works and what does not.

1. Introduction

Making progress on equality, diversity and inclusion is a founding aim of UKRI's organisational strategy. The UKRI Chief Executive, Professor Dame Ottoline Leyser, has called for an "inclusive knowledge economy" where "everyone has the opportunity to participate, and from which everyone benefits". It has been further highlighted through the Black Lives Matter debate in relation to underrepresentation of students from certain ethnic groups, especially Black students among UKRI studentship holders (Williams et al., 2019). In 2020, a widely circulated open letter raised concerns about student recruitment in UKRI DTPs and CTPs[1]. These concerns in the research community reflect broader public debate about inequalities and prejudice on the basis of race/ethnicity and gender, and on the opportunities for those from socio-economically and geographically marginalised groups, to be socially mobile. The current UK government has declared that it is pursuing a 'levelling up' agenda to distribute opportunities more evenly around the country.

These debates and agenda are highly relevant to UK life sciences. The life sciences are a prominent feature of the UK's economic and research landscape, and the renewed emphasis on research as a key element of post-Brexit national strategy point to the continuing importance of the life sciences research workforce. In addition to arguments of fairness and equality, it is vital that life sciences careers are open to those with the talent and potential to enter them, from any background. Furthermore, a life sciences research workforce which reflects the make-up of the UK will ensure that the future agenda for life sciences research incorporates diverse views and emphases to understand and address the scientific challenges of the coming decades.

While there is a growing understanding of the broad patterns of entry to postgraduate research (as the first major step in a research career), such analyses are very much in the aggregate, even where they focus on STEM disciplines. Retention of scientific researchers in academic research is low, as the Royal Society has demonstrated (The Royal Society, 2010), but understanding of early career transitions remains shaky. Better data is needed, but insufficient use has been made of some of the extensive datasets already available. We do know that the structure of early careers in research varies considerably across broad fields. Such variations are seen in the timing and component parts of the early career, such as whether qualifying degrees are typically taken immediately following preceding qualifications or after graduates have spent time in the labour market. They are seen in the institutional concentration or dispersion of doctoral and postdoctoral research and funding, and also in the extent to which early transitions dictate much later outcomes. Understanding this structure and the disciplinary culture within which it is located, is a prerequisite to formulating when, where and how to intervene to address inequalities.

1. Retrieved from: https://docs.google.com/document/d/1EInAKFl7px2DxYv-sAZxVOyTjkmAE29CzFFnjxw6hg/edit

A basis for action on equality, diversity and inclusion in the UK life sciences must therefore begin with an understanding of the field. In this report, we present a wide-ranging description of early career demographics and transitions in the life sciences, using the best available extensive datasets. While the report covers the life sciences in general, we foreground BBSRC disciplines and students as a key element of the field in the UK, particularly in relation to doctoral training. Furthermore, BBSRC has declared its intention to ensure fair and equitable access to its funding opportunities – in the early career and beyond. Doctoral training partnerships and centres funded by BBSRC have also initiated and developed conversations and action intended to widen doctoral participation, with some beacons of good practice emerging. There is thus both a top-down and bottom-up impetus from within BBSRC's research community for a thoroughgoing equality, diversity and inclusion agenda.

In this report, we aim to contribute to this impetus by describing patterns of early-career participation and progression in the life sciences. This descriptive analysis covers four principal phases. First, we outline transition from a first-degree into a higher degree by research in the life sciences as a graduate outcome. We are able to show how this varies according to a range of factors including gender, ethnicity, socio-economic class, prior attainment and location (institutional and geographical). Second, we present data on rates of application, offer and enrolment within BBSRC DTPs to highlight how these vary, sometimes in troubling ways, across applicant characteristics. Third, we investigate progression through a research degree in the life sciences across EDI characteristics, where a more positive picture arises. However, in our final set of analyses, which follows doctoral graduates into the labour market, we see some concerning patterns around entry into academic jobs and EDI measures. Taken together, these different datasets allow us to piece together the landscape of the early research career in the life sciences.

The report is structured as follows. We begin by describing and explaining our datasets, noting their strengths and limitations. We then proceed with our analyses of the different phases of the life sciences early research career. We conclude the report with a broader discussion of the findings.

2. Data and methods of analysis

In this section of the report, we describe the datasets on which our analyses are based and the variables they contain. These datasets are, to the best of our knowledge, the most comprehensive and extensive datasets available to investigate EDI in the life sciences early research career. We focus in the report on UK-domiciled students (although EU-domiciled students are included in some analyses). Our focus is therefore on those students who, at the time of enrolling into higher education, were ordinarily resident in the UK. Many people come to the UK to study life sciences and/or to join the life sciences research workforce. We do not wish to imply, in our focus on UK-domiciled individuals, that EDI issues do not affect international staff and students. Rather, our focus on UK staff and students provides a consistent basis for comparison across the phases. Moreover, there is considerable heterogeneity among international staff and students which make it very difficult to establish a base population to compare with (for instance when looking at socio-economic class or ethnicity).

2.1 Datasets

We use three datasets sourced from the HESA to examine inequalities in access and within doctoral programmes in the life sciences field of studies. HESA is the statutory body for the collection of data about publicly funded and/or regulated higher education institutions in the UK. It has been collecting significant amounts of census and survey data on UK students and graduates for over 25 years. HESA has robust procedures for assuring data quality and coverage. The data analysed here were supplied under licence through HESA's partnership with Jisc. We acknowledge the advice, support and guidance from Jisc colleagues.

The first dataset, which will be referred to henceforth as the transition dataset, comprises all UK-domiciled first-degree graduates between 2012/2013 and 2016/2017. The transition dataset contains information on individuals' characteristics and socioeconomic background; their first-degree subject, attainment and higher education institution; and their first destination after graduation. For individuals who enter postgraduate education after graduation, the dataset has information on the type of qualification and higher education institution attended at that level. The second dataset, referred to as the progression dataset, comprises all UK- and EU-domiciled doctoral entrants in 2011/2012 and 2012/2013 and tracks them either to successful completion, withdrawal/failure, or continued enrolment by 2018/19. The third dataset, referred to as the destination dataset, comprises all UK-domiciled doctoral graduates between 2012/2013 and 2016/2017. The destination dataset includes detailed information on their first destination (employment) three months after graduation and, for a small subset of 2012/2013 graduates, their destination after three years of graduation.

Figure 1 summarises the HESA datasets presented in the report.

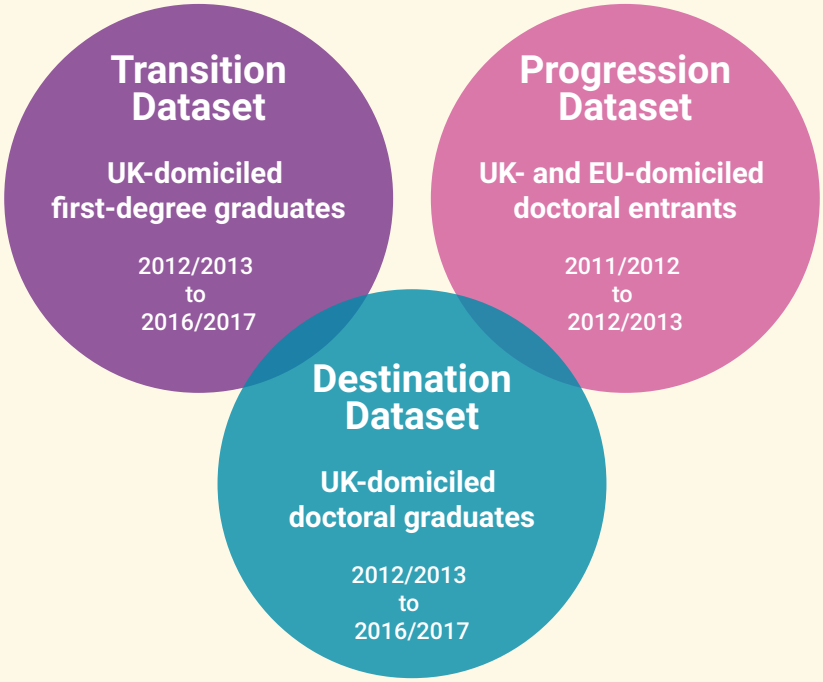


Figure 1. Higher Education Statistical Agency (HESA) datasets.

Finally, aggregate application data has been supplied to us directly by BBSRC. This dataset collates data on doctoral applications, applicants invited to interview and offers made in the years 2016/17 – 2019/20 across BBSRC DTPs and Collaborative Training Partnerships (CTPs). Data is available broken down by certain EDI characteristics (disability, sexual orientation, gender and age). It is not disaggregated into data for each DTP/CTP.

2.2 Variables

Within the HESA datasets, we use the Joint Academic Coding System (JACS) to identify individuals in the life sciences undergraduate and postgraduate degrees in the three datasets. The JACS consist of a code that identifies the subject group, the principal subject and discipline. Table 1 presents the principal subjects in life sciences, which are funded by BBSRC. We also use the JACS to identify Medical and Engineering and Physical Sciences subjects, which are funded, respectively, by the Medical Research Council (MRC) and Engineering and Physical Sciences Research Council (EPSRC) to compare characteristics of doctoral programmes and graduates' outcomes.

To understand higher education institutional inequalities, we have used an established categorisation of the prestige of the UK higher education institutions (Wakeling & Mateos-Gonzalez, 2021). The groupings are as follows:

1. Oxbridge: comprises Oxford and Cambridge universities.

2. Other Golden Triangle: includes prestigious higher education institutions based in London - Imperial College, King's College, University College London and the London School of Economics. These institutions, plus Oxford and Cambridge, are often referred to as the 'Golden Triangle' based on their geographical locations.

3. Other Russell Group: comprises the higher education institutions which are part of the group, except Oxbridge and the Golden Triangle institutions.

4. Non-Russell Group Pre-1992: includes higher education institutions that were created before the Further and Higher Education Act 1992 and are not part of the Russell Group.

5. Post-1992: institutions that were granted the university title after the 1992 Act.

We do not wish to imply any endorsement of institutional prestige hierarchies. However, it is important to recognise that such hierarchies are 'out there' and can be observed in different ways in policy and in data (Boliver, 2015; Wakeling & Savage, 2015).

Table 1. Principal subjects funded by BBSRC

Agriculture	Forestry & arboriculture
Agricultural sciences	Genetics
Animal science	Microbiology
Biology	Molecular biology biophysics & biochemistry
Botany	Others in biological sciences
Broadly-based programmes within biological sciences	Others in veterinary sciences agriculture & related subjects
Broadly-based programmes within veterinary sciences agriculture & related subjects	Pre-clinical veterinary medicine
Clinical veterinary medicine & dentistry	Sport & exercise science

2.3 Analysis

All tables and graphs presented in this report comply with the HESA standard rounding methodology. The rounding methodology consists of rounding all numbers to the nearest multiple of 5 and suppressing percentages based on less than 22.5 individuals and averages based on 7 or fewer individuals. The purpose of the methodology is to avoid identifying individuals in the datasets (HESA, 2021b).

We use average marginal effects (AMEs) to report the regression models presented in the report. AMEs are an intuitive way to interpret regression coefficients for lay readers since they are standardised to allow ready comparison. In the linear regression models, the AME represents the average difference in the outcome for each predictor's categories and its reference group. In the logistic and multinomial logistic models, the AMEs represent the difference in the predicted probability between each predictor's categories and its reference group. Negative AMEs indicates a smaller average or lower probability, while positive AMEs indicates a higher average or probability when compared to the reference groups.

2.4 Limitations

Few datasets are perfect, and ours are no exception. As noted in the section 3 below, we are only able to analyse certain background characteristics for those graduates who move immediately from a first-degree into a research degree. Where there is a break between the two levels, including where a graduate proceeds into a research degree via a taught masters, the data linkage is broken. Our dataset does not contain the very latest available academic years and where we are investigating outcomes longitudinally, it necessarily refers to research students who began their degrees some time ago. As in all secondary data analysis, we must rely on variables and definitions which we did not create, and which might not be ideal for our current purposes. Unfortunately, we are not able to identify, in the transition dataset, which graduates entered a research degree funded by a research council studentship. For the application data, we have only aggregate statistics to work with, which limits the depth of analysis possible. We know that there is some non-response to the destinations survey we use in the transitions and outcomes datasets (although not substantial) and that data coverage on some variables is better than others. Finally, we acknowledge that the disciplinary 'borders' of the life sciences are porous. There is movement both into and out of life sciences academic units between first-degree and research degree study, often from or into 'adjacent' disciplines. Since we need to use standardised disciplinary categories with our data, this unavoidably loses some nuance. For example, a single-honours chemistry graduate entering a biochemistry PhD would, in our dataset, count as changing discipline, whereas a single-honours biology graduate would not. Similarly, a PhD student in a school of life sciences might mainly be engaged with mathematics or computing science research, rather than life sciences ***per se***. Nevertheless, we believe we have utilised the best data readily available to us for our analyses.

3. Transition of first-degree graduates into postgraduate research study

To examine the effect of socioeconomic background on the first destination for UK-domiciled first-degree graduates, we use the transition dataset. We use the coarsened exact matching (cem)[2] method (Iacus et al., 2012) to match every individual who transitioned to a postgraduate research degree in the life sciences (treatment group) with individuals with the same undergraduate academic background characteristics (control group). To measure academic background, we use variables for UCAS tariff, level of qualification and principal subject of the first-degree. Therefore, the control group comprises first-degree graduates with the same academic credentials as those who entered a postgraduate degree in the life sciences subjects[3].

It is important to highlight that the data used in this section only allows us to track immediate transition after the first-degree. Therefore, we are only comparing differences in the characteristics and socioeconomic background for first-degree graduates who immediately transitioned to a postgraduate research degree in the life sciences with their academically equivalent peers who did not. We do not capture individuals with a non-consecutive transition to a postgraduate research degree (e.g.: individuals who first pursue a master's degree or enter the labour market). Nevertheless, according to HESA data, a large number of students in the life sciences postgraduate research degree transition directly from undergraduate (see Table 2).

Table 2. Number of UK-domiciled postgraduate research students who transitioned immediately after first-degree (transition dataset) and the number of UK-domiciled first-year postgraduate research students in the life sciences by academic year.

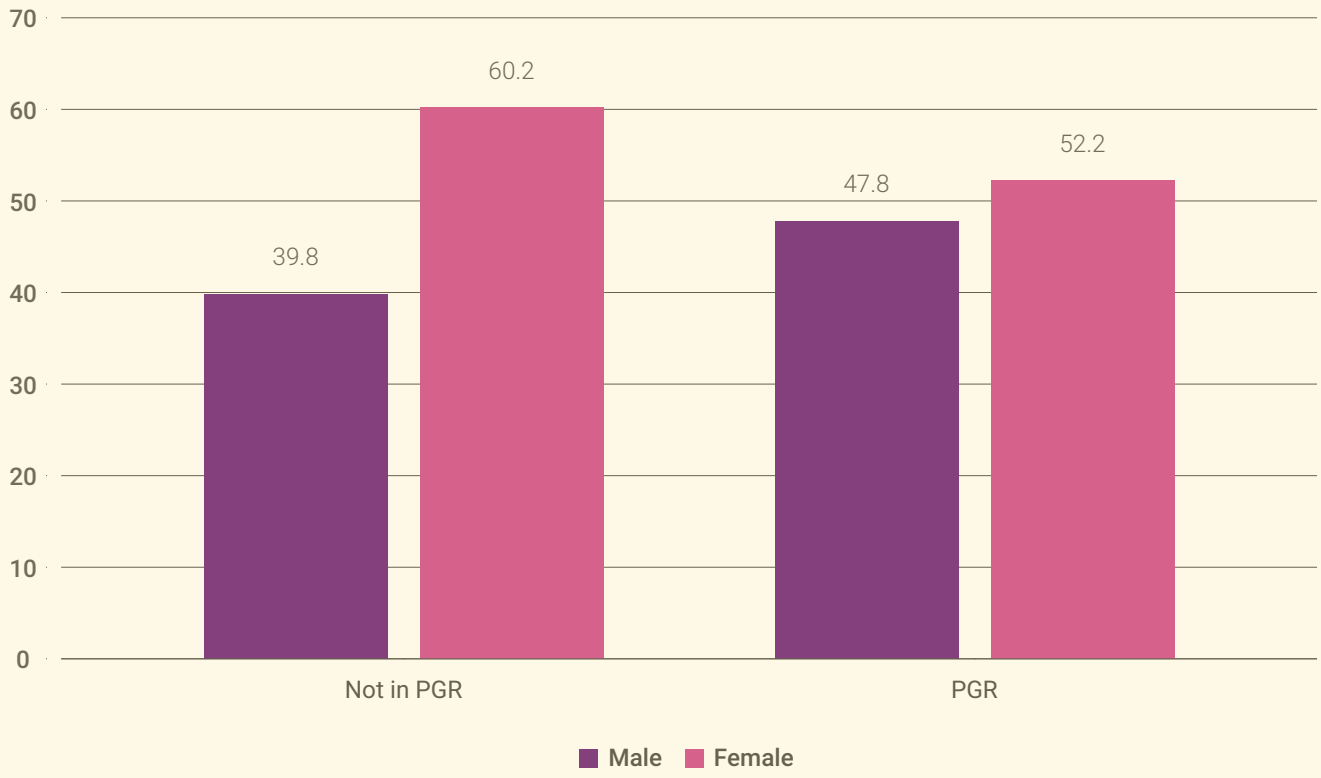
Academic Year	Transition Dataset	First-Year PGR
2012/2013	960	1045
2013/2014	1050	1130
2014/2015	905	1190
2015/2016	1110	1140
2016/2017	1190	1290
Total	5215	5795

Source: *HESA data*

2. The cem method reduces imbalance in the covariates between treatment and control group, reducing model dependence and increasing power and efficiency (smaller confidence intervals and standard errors). The matching procedure allows us to temporarily coarsen the covariates (in our case, academic background) and apply the exact matching for all individuals in the treatment group. Individuals are then sorted into strata and individuals in a stratum without treated units are excluded from the analysis. In the analysis, a weight is used to account for individuals in the treatment group who were matched with more than one individual. The cem method was performed using the 'cem' Stata command (Blackwell et al., 2009)

3. Appendix A compares first-degree graduates in the life sciences subjects who pursue a clinical and an academic route immediately after graduation against EDI characteristics.

Figure 2 shows the distribution for sex by whether first-degree graduates immediately transitioned to a postgraduate research degree in the life sciences subjects. The majority of the first-degree graduates are female (respectively, 60.2 and 52.2%). Nevertheless, the odds of immediately transitioning to a postgraduate research degree are higher for male first-degree graduates (1 in 234 for males and 1 in 325 for females), showing gender inequalities in access to a postgraduate degree in the life sciences. Thus, while males are (just) in the minority of those transitioning to a research degree, they are progressing at a rate quite a bit higher than we would expect. This overrepresentation is not unique to life sciences (Leslie et al., 2015), but it may be somewhat hidden compared to the more obvious underrepresentation of women in other STEM fields.

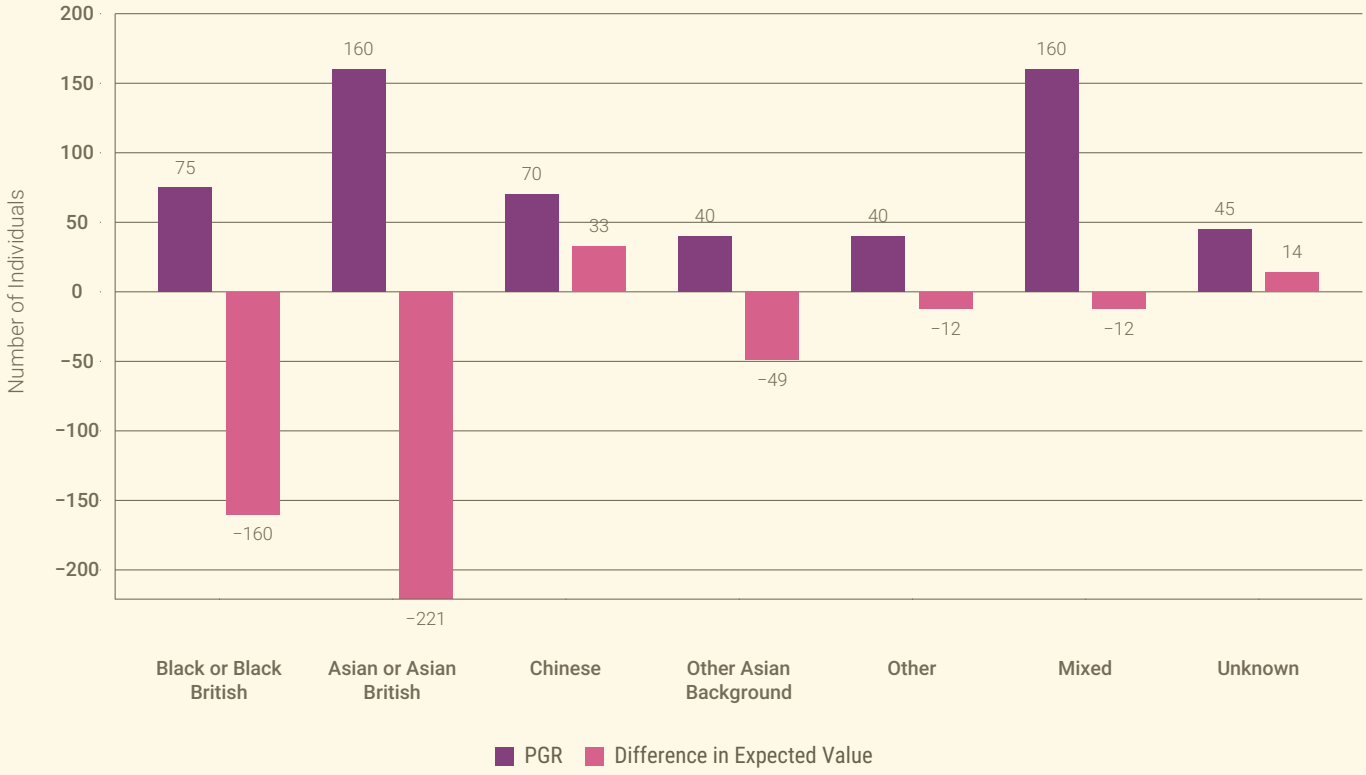


Source: *HESA data*

Figure 2. Frequency distribution for sex by whether first-degree graduates transitioned to a life sciences postgraduate research degree.

Research on race/ethnic inequalities has shown that first-degree graduates from minority groups are more likely to pursue a postgraduate taught degree immediately after graduation as a mechanism to avoid unemployment or underemployment (e.g.: Lessard-Phillips et al., 2018; Wakeling, 2009). Nevertheless, little is known about the impact of race on the transition to a postgraduate research degree. Figure 3 shows the number and the difference in the expected number of individuals who should have transitioned based on

first-degree graduates academically qualified to a life sciences postgraduate research degree. Individuals who declared being Black or Black British, Asian or Asian British (Indian, Pakistani and Bangladeshi) and Other Asian backgrounds are less likely to transition to a research degree than other ethnicities. Based on the number of first-degree graduates academically qualified, we would expect three times the number of Black or Black British and about twice the number of Asian or Asian British and Other Asian backgrounds. The comparison also shows that UK first-degree graduates of Chinese and Unknown ethnicities are more likely to transition to a life sciences research degree than those of other ethnicities.



Source: *HESA data*

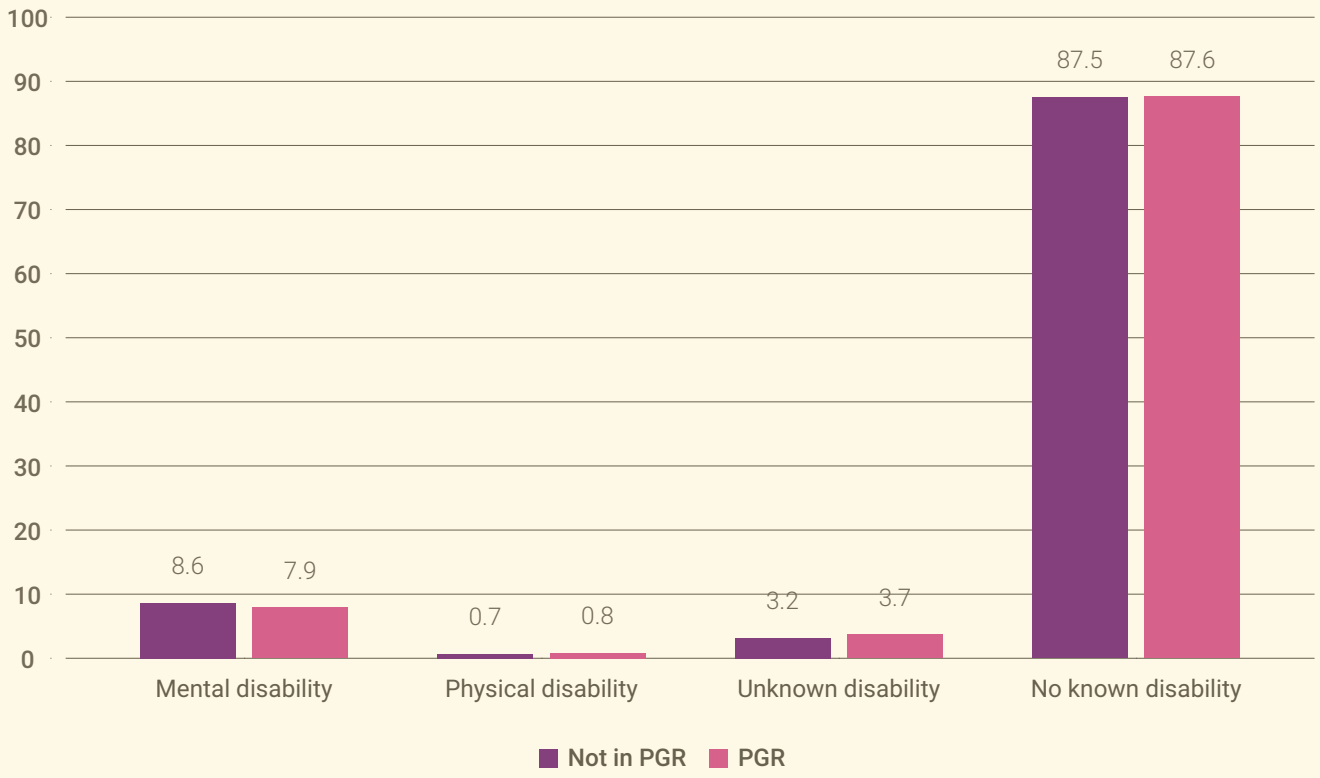
Notes:

(1) The number of individuals who declared being White is omitted in the graph, due to a large number of cases. The number of White first-degree graduates who transitioned to a life sciences postgraduate research degree is 4,630 and, based on the number of White first-degree graduates qualified, an additional 407 individuals made the transition.

(2) The categories Black or Black British Caribbean, African and Other Black background were grouped into one category due to the small number of cases. Otherwise, they would be suppressed according to the HESA rounding methodology.

Figure 3. Number of individuals who immediately transitioned to life science postgraduate research degree and difference in the expected number of individuals based on academically qualified first-degree graduates by ethnicity

A recent study shows that PhD students in the UK are more likely to report some level of mental health problems when compared to the general public (Hazell et al., 2021). Over 70% of the doctoral research students in the sample reported having depression and anxiety symptoms during the PhD. Nevertheless, at the time of transition from first-degree to postgraduate research degree, only 12.4% of the students who transitioned to a postgraduate research degree in the life sciences reported having any disability (including mental disability). Moreover, there is not any clear indication that students who reported having a disability (mental, physical and unknown disability) have different probabilities of pursuing a postgraduate research degree when compared to students who did not report having any disabilities.

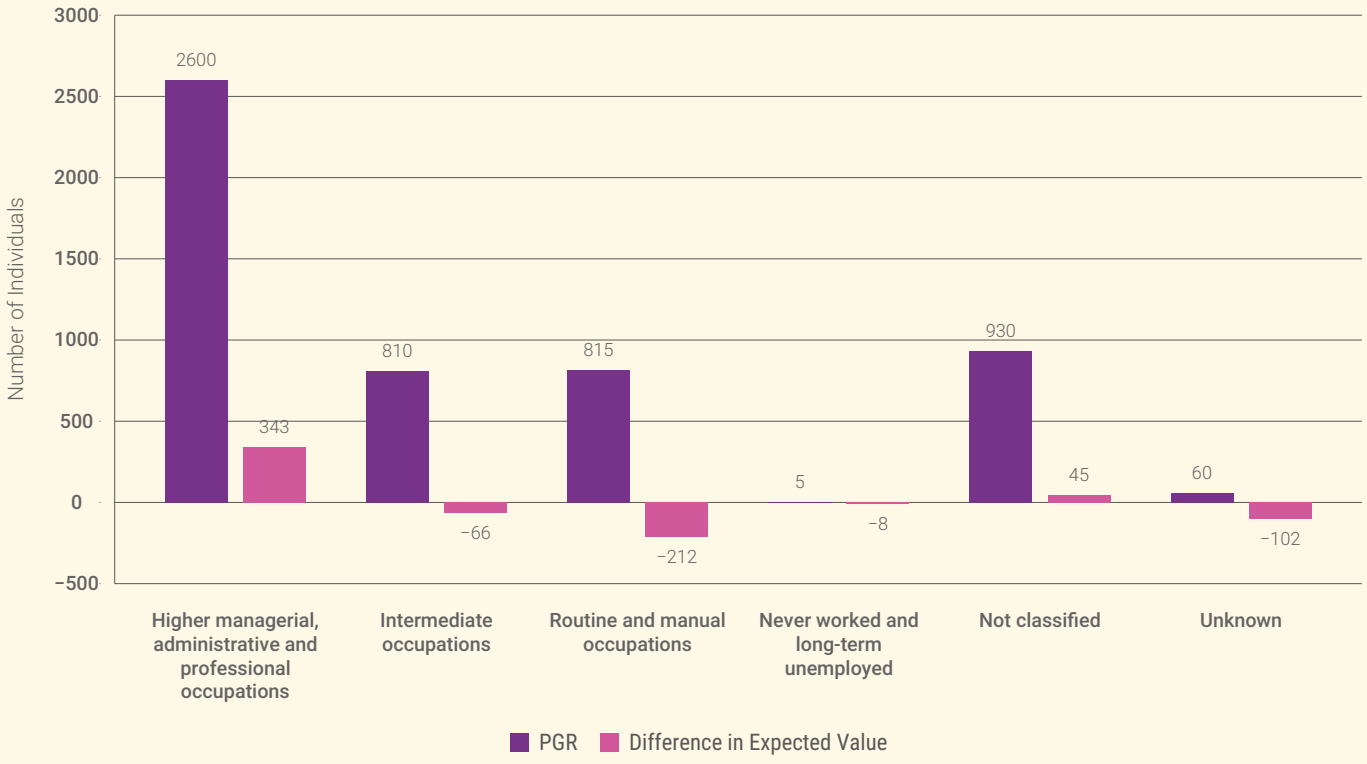


Source: *HESA data*

Figure 4. Frequency distribution for self-reported disability by whether first-degree graduates transitioned to a life sciences postgraduate research degree.

Figure 5 presents the number and the difference between the expected and actual number of individuals who transitioned to a life sciences postgraduate research degree by socioeconomic background using the National Statistics Socioeconomic Classification (NS-SEC). The NS-SEC is based on the occupation of the highest earner in the graduate's household. For graduates under 21 years old, the NS-SEC of the parent or guardian's household is recorded, and, for students 21 years old and over, their own household NS-SEC is recorded. Information on the NS-SEC is compulsory for UK-domiciled students (HESA, 2021a).

First-degree graduates who have a socioeconomic background of higher managerial, administrative and professional occupation are more likely to transition to a postgraduate research degree in life sciences when considering the expected number. Moreover, first-degree graduates from intermediate and routine and manual occupations are less likely to transition to a postgraduate research degree immediately after the first-degree.

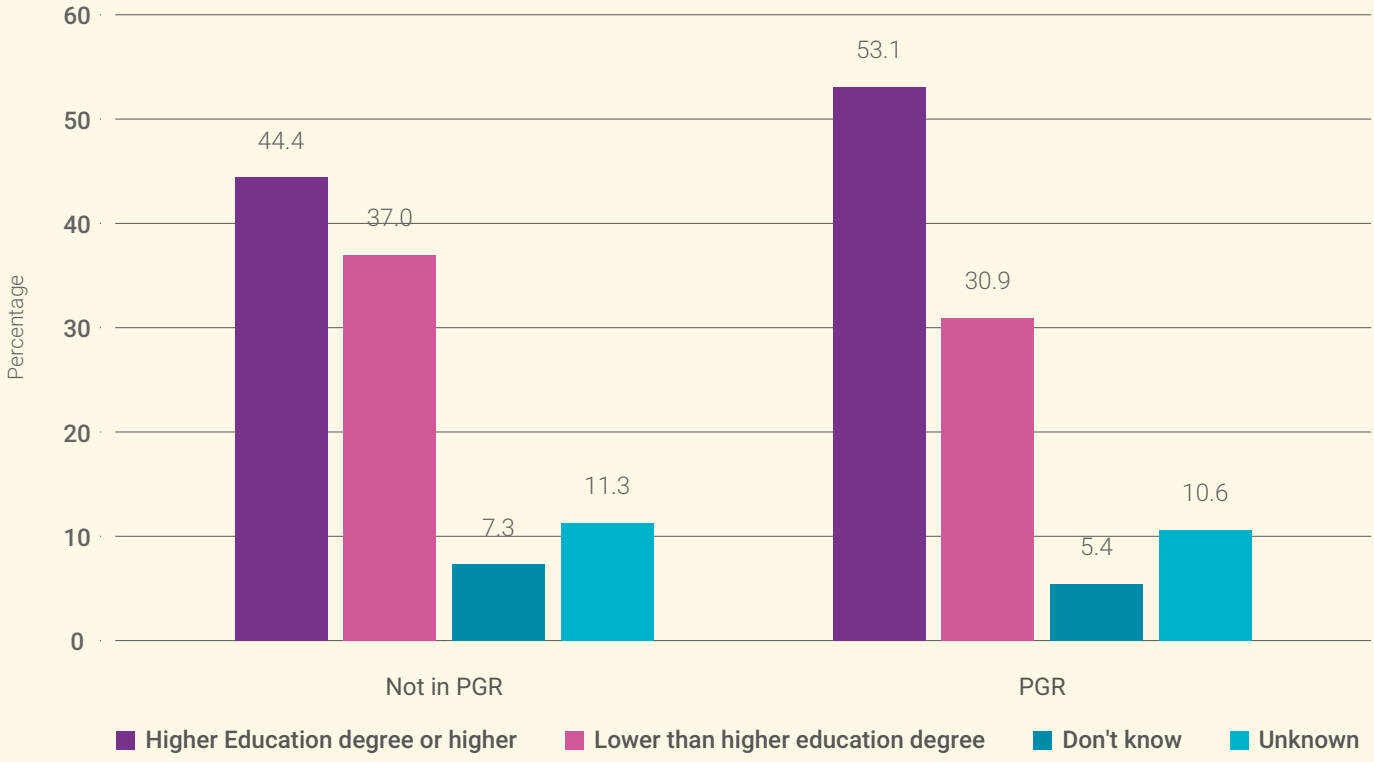


Source: *HESA data*

Figure 5. Number of individuals who immediately transitioned to life sciences postgraduate research. Degree and difference in the expected number of individuals based on academically qualified first-degree graduates by socioeconomic classification.

Figure 6 shows the frequency distribution for parental education. A higher proportion of first-degree graduates who immediately transitioned to a postgraduate research degree in a life sciences discipline have a parent with a higher education degree (53.1%) when compared to first-degree graduates with similar academic qualifications (44.4%). First-degree graduates with a parent with a higher education degree might have more knowledge of different academic trajectories and their advantages and risks, therefore, they might have invested in the required skills and dispositions to pursue a postgraduate degree.

The positive association between socioeconomic background and transition to a postgraduate degree in the life sciences is consistent with the finding on inequalities in access to postgraduate education in the UK and European countries (e.g.: Wakeling and Hampden-Thompson, 2013; Wakeling and Laurison, 2017).



Source: *HESA data*

Figure 6. Frequency distribution for parental education by whether first-degree graduates immediately transitioned to a life sciences postgraduate research degree.

Table 3 presents the type of higher education institution attended for the first-degree by whether individuals transitioned to a postgraduate research degree in life sciences subjects. As been shown in the recent study by the Institute of Fiscal Studies (Van Der Erve et al., 2021), there are large inequalities in access to selective higher education institutions at the undergraduate level in the UK and higher education institution has a significant impact on labour market outcomes and, consequently, social mobility. Therefore, it is important to understand the institutional trajectory of postgraduate research students.

Table 3. Type of higher education institution of first-degree by whether first-degree graduates immediately transitioned to a life sciences postgraduate research degree.

HEI Type	Not in PGR		PGR		Total	
	N	%	N	%	N	%
Oxbridge	21,790	1.48	430	8.28	22,220	1.51
Other Golden Triangle	29,670	2.02	235	4.54	29,905	2.03
Other Russell Group	332,835	22.67	2,335	44.71	335,165	22.75
Non-RG pre-1992	340,960	23.23	1,245	23.88	342,205	23.23
Post-1992	742,645	50.59	970	18.58	743,615	50.48
Total	1,467,895	100.00	5,220	100.00	1,473,110	100.00

Source: *HESA data*

The majority of first-degree graduates who transitioned to a postgraduate degree studied in a Russell Group institution (57.5%), while 50.6% of the first-degree graduates who did not transition to a postgraduate research degree studied in post-1992 institutions. This table indicates that the type of higher education institution plays an important role in transitioning to a postgraduate research degree in the life sciences subjects.

KEY POINTS

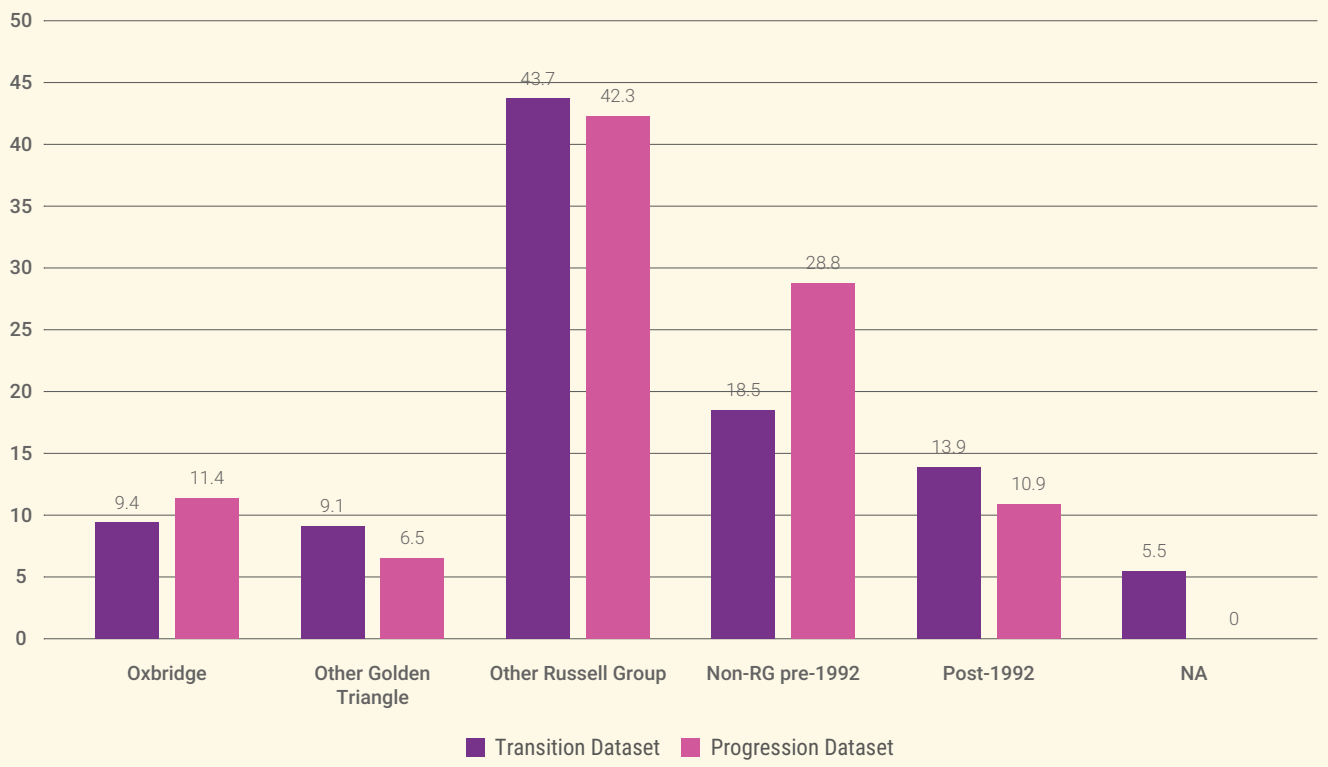
Among those who are similarly qualified, women, and Black and Asian first-degree graduates transition to a postgraduate research degree in the life sciences at a lower rate than expected. Men and White graduates have a higher than expected rate of transition.

The association between socioeconomic background and transition to a life sciences postgraduate research degree is similar to that found in previous research. Taking into account academic background, those with parents in professional/managerial employment and of graduate status are more likely to proceed to a research degree.

While graduates of post-1992 universities make up the majority of first-degree graduates in the life sciences, the majority of first-degree graduates who transitioned to a life sciences postgraduate research degree studied in a Russell Group University for their undergraduate degree.

3.1 Type of higher education institution for postgraduate research degrees in the life science subjects.

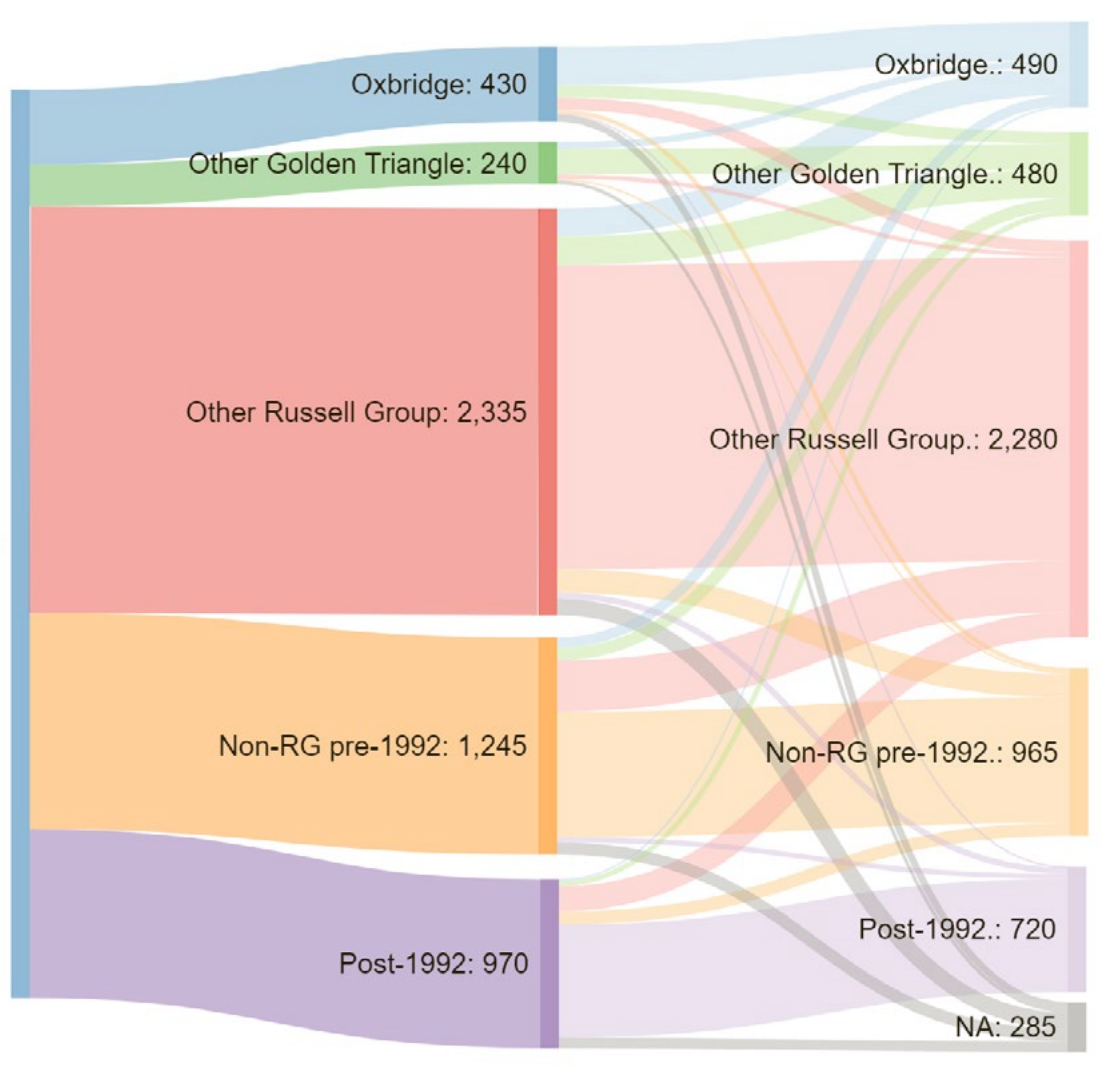
The effect of UK higher education institutional stratification on graduates' outcomes is not exclusive to undergraduate degrees, but also has an impact on the postgraduate level (Pásztor & Wakeling, 2018; Wakeling & Savage, 2015). This section investigates the association between the type of higher education institutions of postgraduate research degree and individuals' characteristics and socioeconomic background for those who transitioned to a postgraduate degree after the undergraduate degree. Of the 5,220 first-degree graduates who immediately transitioned to a postgraduate research degree in the life sciences, 62.2% attended a Russell Group, 18.5% a pre-1992 and 13.9% a post-1992 higher education institution (see Figure 7). The distribution of the type of higher education institution for UK-domiciled first-degree graduates who immediately transitioned to a postgraduate research programme (transition dataset) is similar to the distribution for UK-domiciled doctoral entrants in 2011/2012 and 2012/2013 (progression dataset). Nevertheless, the latter has a higher proportion of individuals in Non-RG Pre-1992 higher education institutions.



Source: *HESA data*

Figure 7. Type of higher education institution of the doctoral programmes entered by UK-domiciled first-degree graduates who immediately transitioned to a postgraduate research degree in the life sciences between 2012/2013 and 2016/2017 (transition dataset) and for UK-domiciled doctoral entrants in 2011/2012 and 2012/2013 (progression dataset).

There is a strong association between the type of higher education institution of the first-degree and the type of higher education institution of the postgraduate research degree. Individuals who immediately transitioned to a doctoral programme in the life sciences subjects tend to study in the same or similar HEI to the first-degree (see Figure 8). Even though there is a small drift 'upwards' (individuals who attended a Non-RG Pre-1992 and Post-1992 institutions in their first-degree entering Other Russell Group institutions for their postgraduate research degree and individuals who attended Other Russell Group institutions entering Oxbridge and Other Golden Triangle institutions), in general, there is very little long-range mobility (up or down). In other words, there is not much institutional mobility in total between undergraduate and postgraduate research degrees.



Source: *HESA data*

Figure 8. Institutional mobility between first and postgraduate research degrees in the life sciences subjects for individuals who transitioned immediately after the undergraduate degree.

Figure 9 presents the frequency distribution for the characteristics and socioeconomic background for individuals who immediately transitioned to a postgraduate research degree in the life sciences after first-degree by type of higher education institution of the doctoral programme. Race inequalities among individuals who transitioned to a postgraduate research degree are significant in all types of higher education institutions. Nevertheless, other Golden Triangle higher education institutions have a higher proportion of Black, Asian and minority ethnic (BAME) backgrounds when compared to other

types of institutions, which might be explained by their location[4]. Regarding individuals' socioeconomic backgrounds, students who transitioned to a postgraduate degree in the life sciences in Oxbridge universities tend to be from more privileged socioeconomic backgrounds when compared to other types of higher education institutions. They have a higher proportion of parents in parents with higher managerial and professional occupations (40%) and with at least one parent with a higher education degree (66%).

CHARACTERISTICS AND SOCIOECONOMIC BACKGROUNDS OF POSTGRADUATE RESEARCH DEGREE STUDENTS

BY

TYPE OF HIGHER EDUCATION INSTITUTION

for individuals who transitioned to a postgraduate degree immediately after first-degree

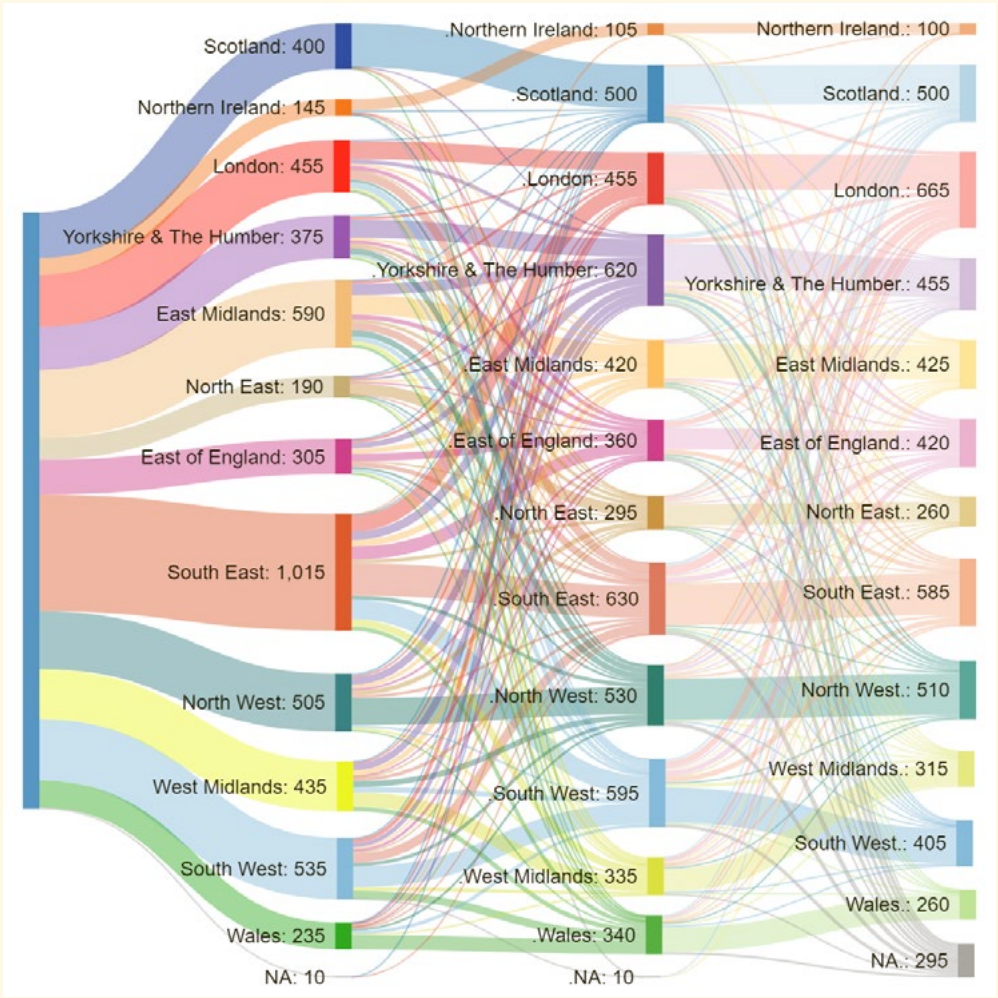
	OXBRIDGE	GOLDEN TRIANGLE	RUSSELL GROUP	PRE-1992	POST-1992
PERCENTAGE OF FEMALE STUDENTS	48%	55%	55%	48%	50%
PERCENTAGE OF WHITE STUDENTS	90%	78%	91%	87%	87%
PERCENTAGE WITH PARENT IN HIGHER MANAGERIAL & PROFESSIONAL OCCUPATION	40%	30%	27%	20%	14%
PERCENTAGE WITH ONE PARENT WITH A HIGHER EDUCTION DEGREE	66%	59%	56%	46%	40%

Source: *HESA data*

Figure 9. Characteristics and socioeconomic background of first-degree graduates who transitioned to a postgraduate degree in the life sciences by type of higher education institution

4. According to the UK Census 2011, individuals from BAME backgrounds are more likely to live in London than any other region in the country: 58.4% for Black, 35.9% for Asian, 33.1% for Mixed and 49.9% for other backgrounds (UK Census, 2011). The others higher education institutions in London have similar proportion of BAME postgraduate research students.

Figure 10 presents the regional mobility between usual home address, location of first-degree and postgraduate research degree institutions in life sciences subjects for individuals who transitioned immediately after the undergraduate degree. There is substantial mobility between the region of the domicile and region of the first-degree, with a large influx of first-degree students in life sciences to Scotland, Yorkshire & the Humber, North East of England, and Wales. Nevertheless, while there is not much as much regional mobility between first- and postgraduate degrees, there is a 'brain gain' for London and the East of England and 'brain drain' in Yorkshire & The Humber, South East of England and Wales.



Source: *HESA data*

Figure 10. Regional mobility between home domicile, first and postgraduate research degrees in the life sciences subjects for individuals who transitioned immediately after the undergraduate degree

KEY POINTS

The majority of first-degree students who transitioned to a postgraduate degree immediately after graduation enrolled for their doctoral degree in a Russell Group university.

There is a high association between the type of higher education institution of the first and postgraduate degree.

Inequalities at the undergraduate level are maintained at the postgraduate research level. Postgraduate research students in Oxbridge universities are from more advantaged socioeconomic backgrounds when compared to other types of higher education institutions.

Student regional mobility is higher from domicile to first-degree than from first-degree to a postgraduate research degree. Nevertheless, there is a brain gain in the postgraduate research in the East of England and London.

4. Doctoral applicants

To fully understand entry to the early career, it is not sufficient only to look at those who ended up enrolling. We also need to understand who sought to enrol, and for this, we used anonymous doctoral applicant data between 2017/2018 and 2019/2020 provided by BBSRC. We examine the profile of applicants to the PhD programmes through DTPs and their relative rates of success on being invited to an interview and receiving an offer of a place to study. Figure 11 show the UK map with the current DTPs supported by BBSRC[5].

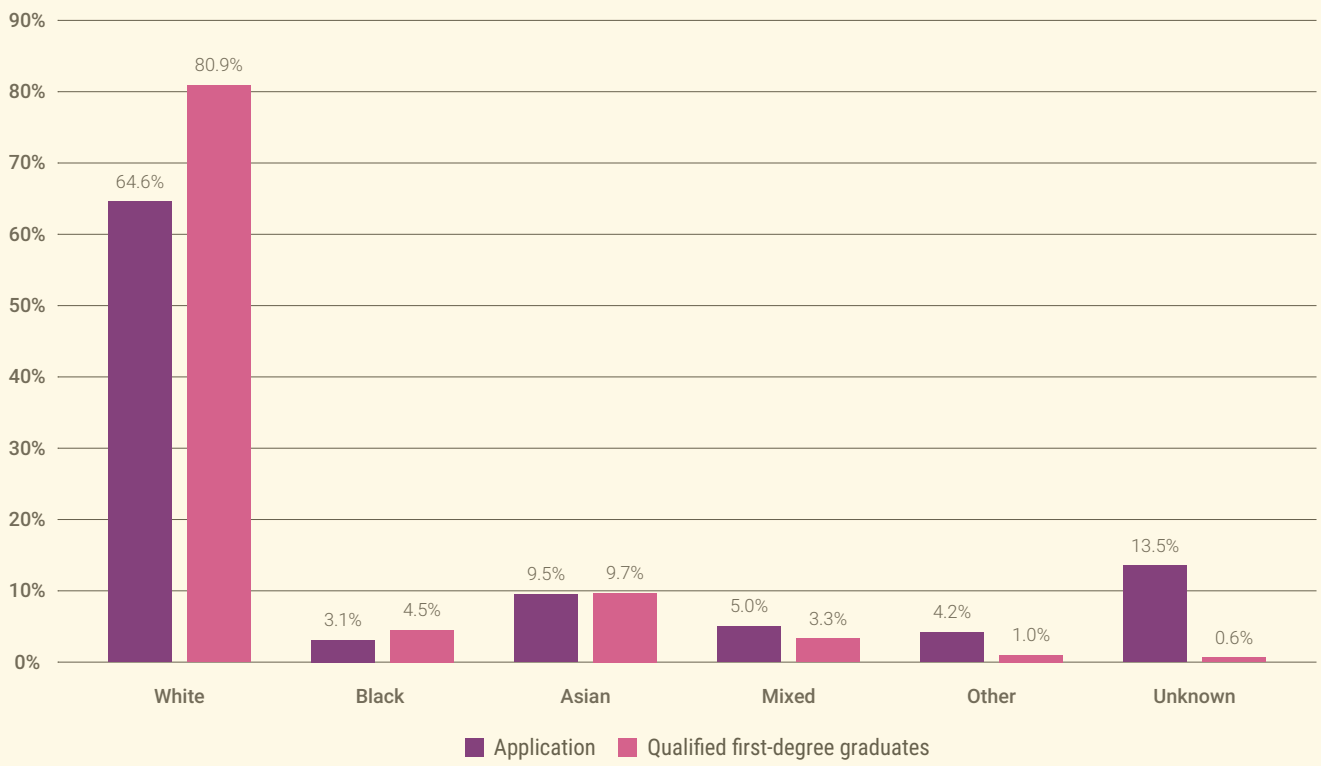
Source: *BBSRC*

Figure 11. Map of BBSRC DTPs, lead organisations and full partners (individual pins denote institutions; each DTP has different coloured pins)

5. See Appendix B for the list of the lead organisations and full partners in 2021.

After analysing the data on doctoral applicants, we did not find any inequalities regarding sex, sexual orientation, or disability when comparing the number of applications, interviews and offers. Nevertheless, as shown by ***The Broken Pipeline*** report (Williams et al., 2019), there are substantial race/ethnic inequalities in access to BBSRC funded DTPs.

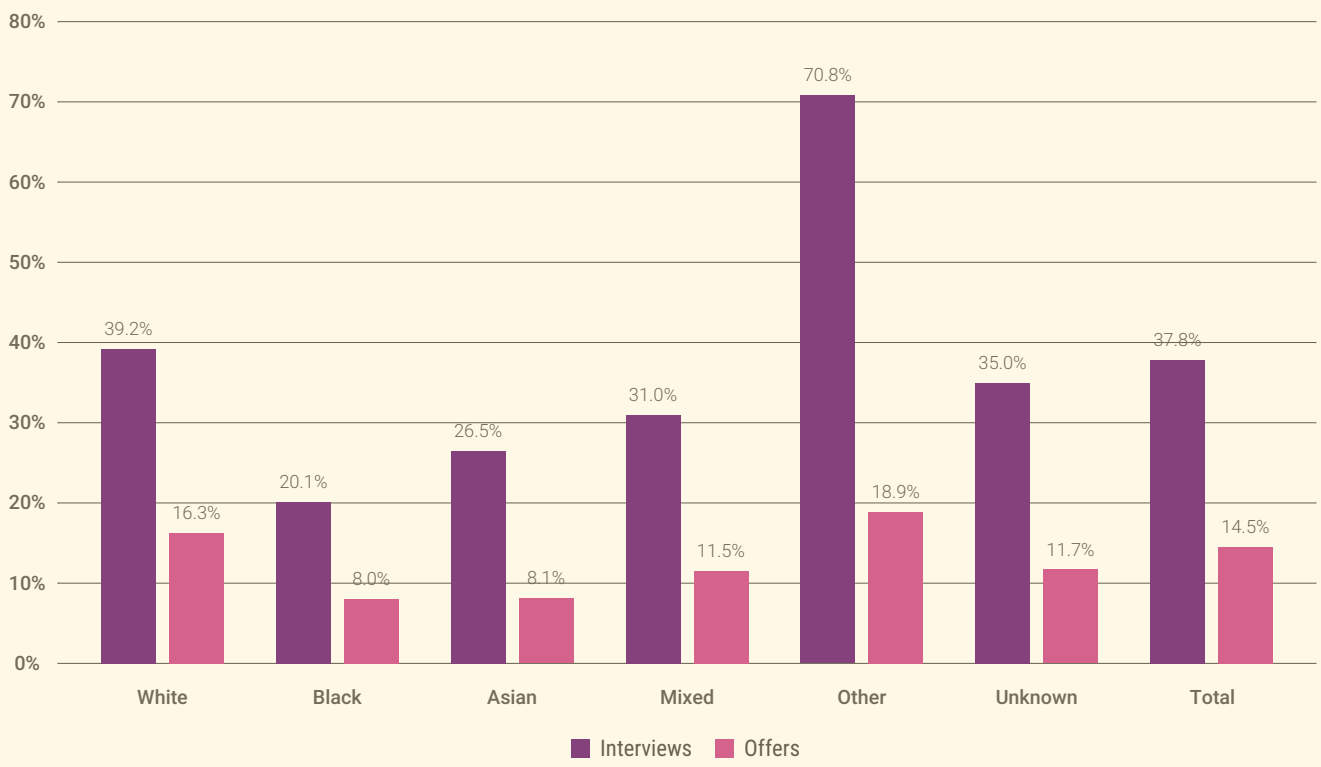
First, we compared the number of applicants to BBSRC's DTPs with the reference population of qualified first-degree graduates (from the transition dataset) to assess the representativeness of the applicant pool. Even though there is a higher percentage of White graduates academically qualified, the distribution shows that minority groups are equitably represented in the application pool (see Figure 12). However, the relatively high proportion of unknown ethnicity applicants makes interpretation more challenging.



Source: BBSRC

Figure 12. Frequency distribution of ethnicity of applicants to BBSRC's DTPs and first-degree graduates qualified for a postgraduate research degree in the life sciences (transition dataset).

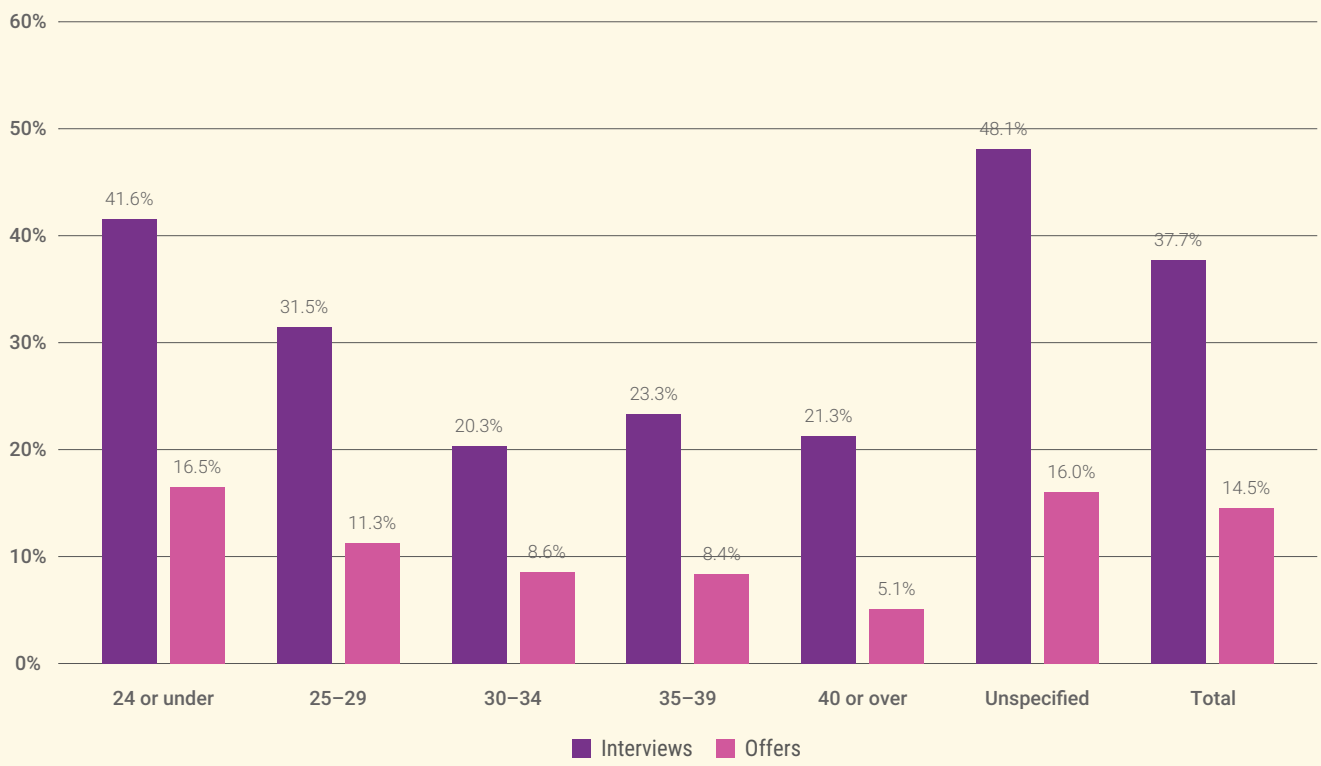
Next, we compared the probability of being invited for an interview and having a successful application for each ethnicity group (see Figure 13). Individuals who declared being White and of 'Other' ethnicity have a higher probability of a successful application (respectively, 16.3% and 18.9%) when compared to minority groups. In contrast, for individuals who declared being Black (N=313) or Asian (N=959), respectively, 20.1% and 26.5% were invited for an interview and 8.0% and 8.1% had a successful application for BBSRC's DTPs programme. Therefore, Black and Asian applicants have half of the probability of receiving an award from these programmes when compared to White applicants.



Source: *BBSRC*

Figure 13. Percentage of individuals invited for interview and with a successful application in BBSRC's DTPs by ethnicity.

Figure 14 shows the percentage of individuals invited for an interview and with a successful application by age. The graph shows a clear trend: the older the applicant the less likely they will be invited for an interview and receive funding for their doctoral programme.



Source: *BBSRC*

Figure 14. Percentage of individuals invited for interview and with a successful application in BBSRC's DTPs by age.

KEY POINTS

The proportion of applicants from ethnic minority groups to BBSRC DTPs is broadly representative of the population of first-degree graduates.

Black and Asian applicant are less likely to be invited for an interview or have a successful application than White applicants.

Older applicants are less likely to be funded by BBSRC.

5. Doctoral programme

Figure 15 shows the doctoral programme characteristics for UK-domiciled doctoral graduates between 2012/2013 and 2016/2017 (destination dataset). A marginally higher proportion of individuals among life sciences doctoral graduates were in the Oxbridge, pre-1992 and post-1992 higher education institutions when compared to medical and engineering and physical sciences doctoral graduates. Regarding the major source of fees for the doctoral programme, 28.3% of the graduates in life sciences did not receive any award or did not have any financial backing. Also, 28.3% of the life sciences graduates received a Research Council or British Academy[6] scholarship, compared to 15% of medical and 32% of engineering and physical sciences graduates.

We also examined the association between life sciences graduates' sex, ethnicity, type of higher education institution for the postgraduate research degree, and major sources of fees using a logistic regression model. Figure 16 presents the average marginal effects for the categories "Research Council & British Academy" and "No award or financial backing".

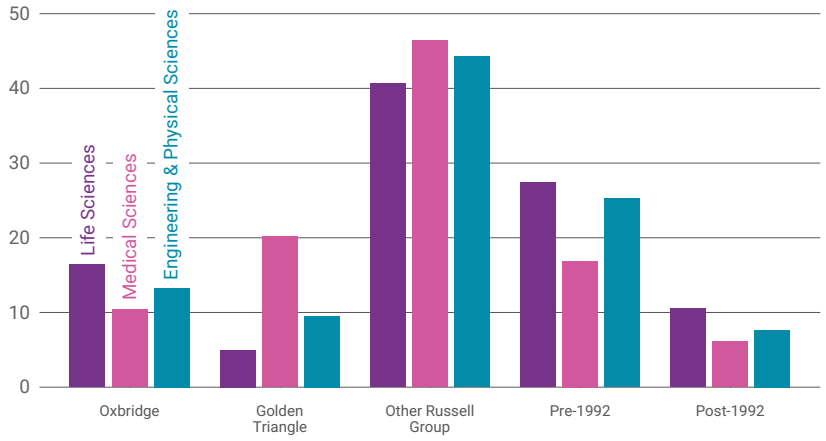
While there is no gender difference in the probability of not being self-sponsored, female graduates were less likely to be research council-funded after controlling for ethnicity and type of higher education institution. Black and Black British graduates were more likely to be self-sponsored and less likely to have a research council award when compared to White graduates in the life sciences, confirming the concerns raised in the open letter to UKRI (Giles et al., 2020) and the finding from the Broken Pipeline report (Williams et al., 2019).

Moreover, there are striking institutional inequalities on graduates' major source of fees for the postgraduate research degree. Graduates from Oxford and Cambridge universities were more likely to receive research council funding than any other type of higher education institution. As has been shown in this report, doctoral students from the Oxbridge institutions and UKRI councils were also more likely to be individuals from privileged socioeconomic backgrounds (parents in managerial occupations and with a higher education degree).

6. The category 'Research Council & British Academy' is that used by HESA. The British Academy previously provided research studentship funding in the arts and humanities, but this role has subquently been transferred to AHRC.

DOCTORAL PROGRAMME

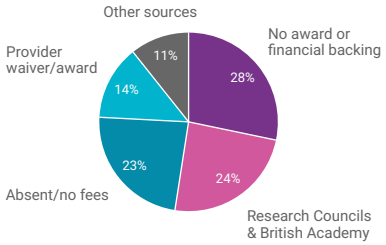
Characteristics of the doctoral programme for individuals who graduated between 2012/2013 and 2016/2017 in the life sciences subjects



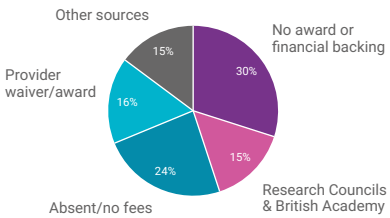
MODE OF STUDY
About **90%** of the graduates in the life sciences subjects studied full-time.

MAJOR SOURCE OF FEES

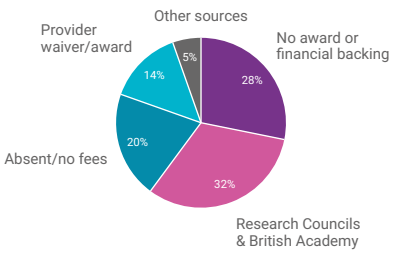
Life Sciences



Medical Sciences

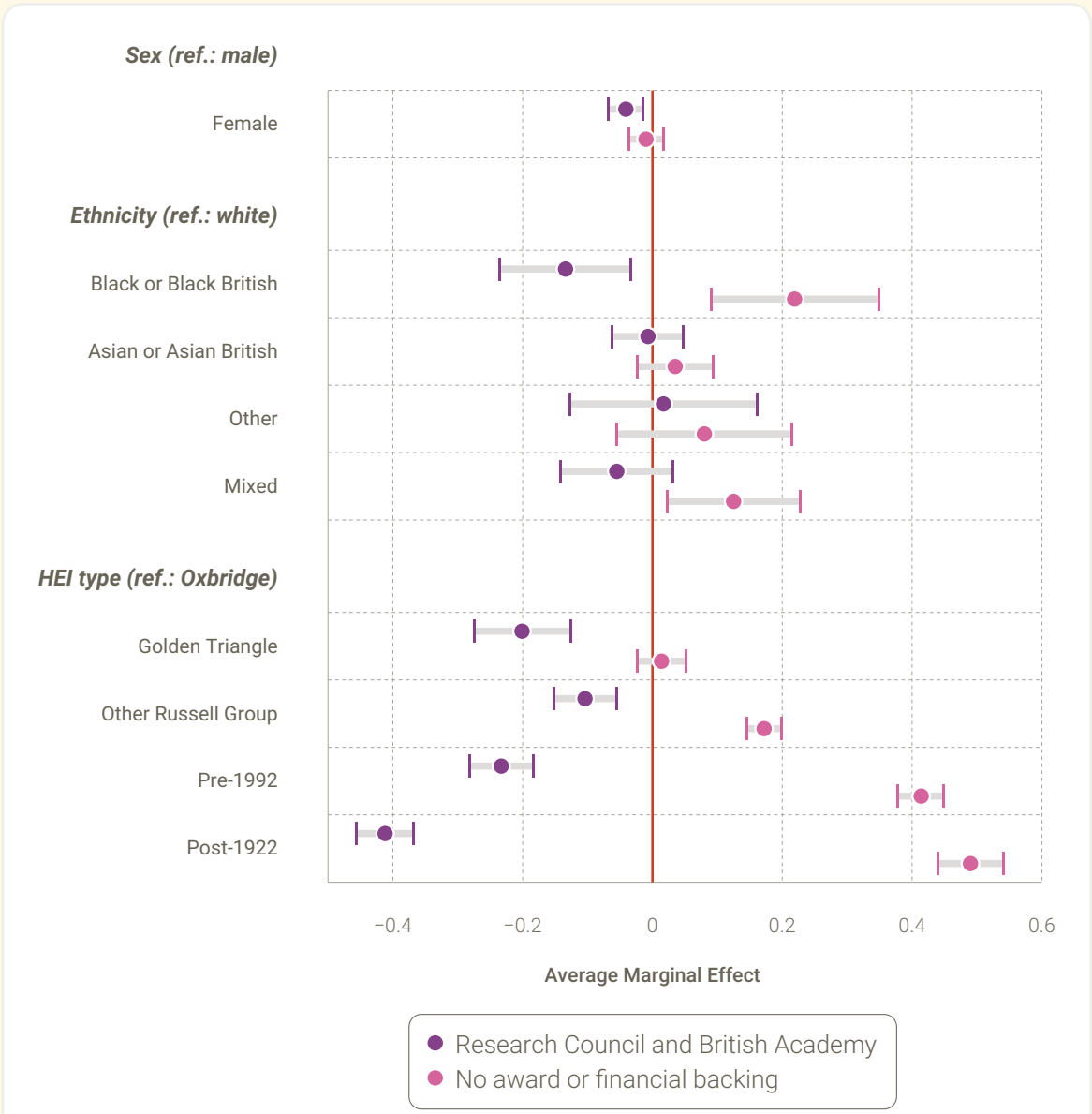


Engineering & Physical Sciences



Source: *Higher Education Statistics Agency*

Figure 15. Summary statistics of the doctoral programme information for postgraduate research graduates in life sciences subjects.



Data Source: *Higher Education Statistics Agency*

Figure 16. Average marginal effects for the predicted probability of receiving funding from the Research Council & British Academy and of not having an award of financial backing during the postgraduate research degree for life sciences graduates.

KEY POINTS

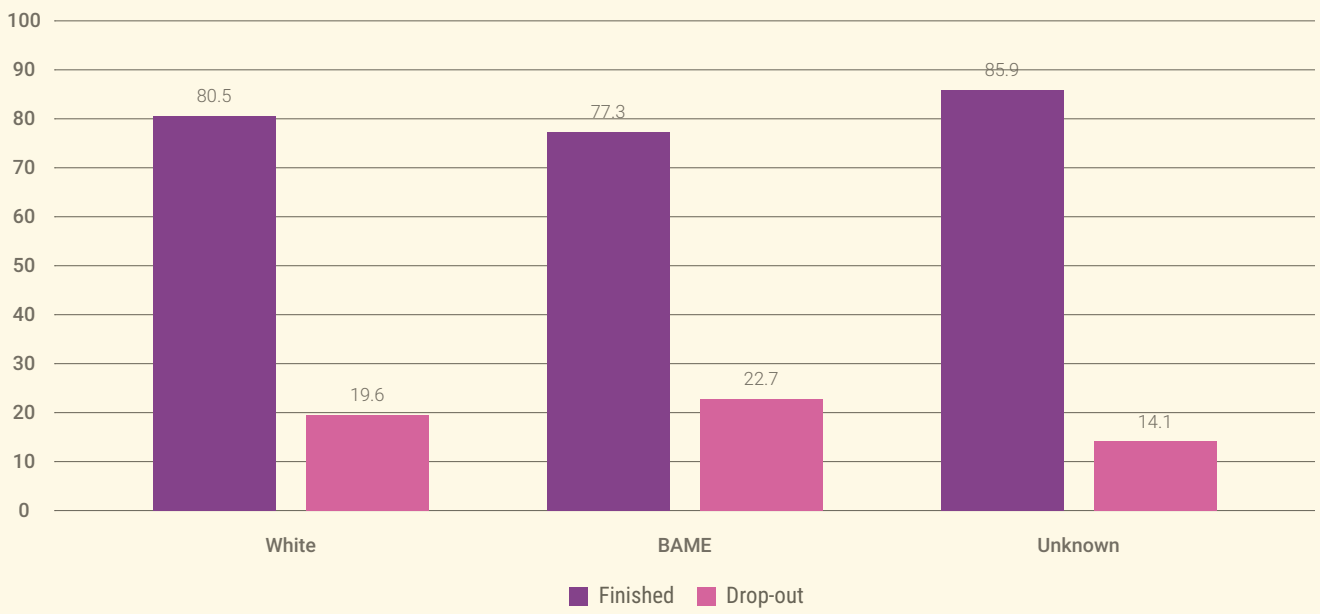
Black or Black British postgraduate research students are less likely to receive research council funding in the life sciences when compared to White postgraduate research students, after controlling for gender and type of higher education institution.

Postgraduate research students from Oxbridge are more likely to receive research council studentship funding compared to other types of higher education institutions.

6. Progression of doctoral students in the life sciences

Using the dataset on the UK and EU-domiciled doctoral cohorts in the life sciences in 2011/2012 and 2012/2013 for all UK higher education institutions, we track doctoral students through and out of their programme and examine the difference in trajectories by socioeconomic background, gender, ethnicity, the major source of fees and type of higher education institution.

About 18% of the doctoral students in the life sciences did not finish their studies[7]. Figure 17 shows the percentage of students who finished and who dropped out by whether the students are from White, BAME and Unknown backgrounds. While the difference between White and BAME students is not substantial, the disaggregated variable for ethnicity indicates that students who identify as Black and British are more likely to drop out compared to other minority groups[8].



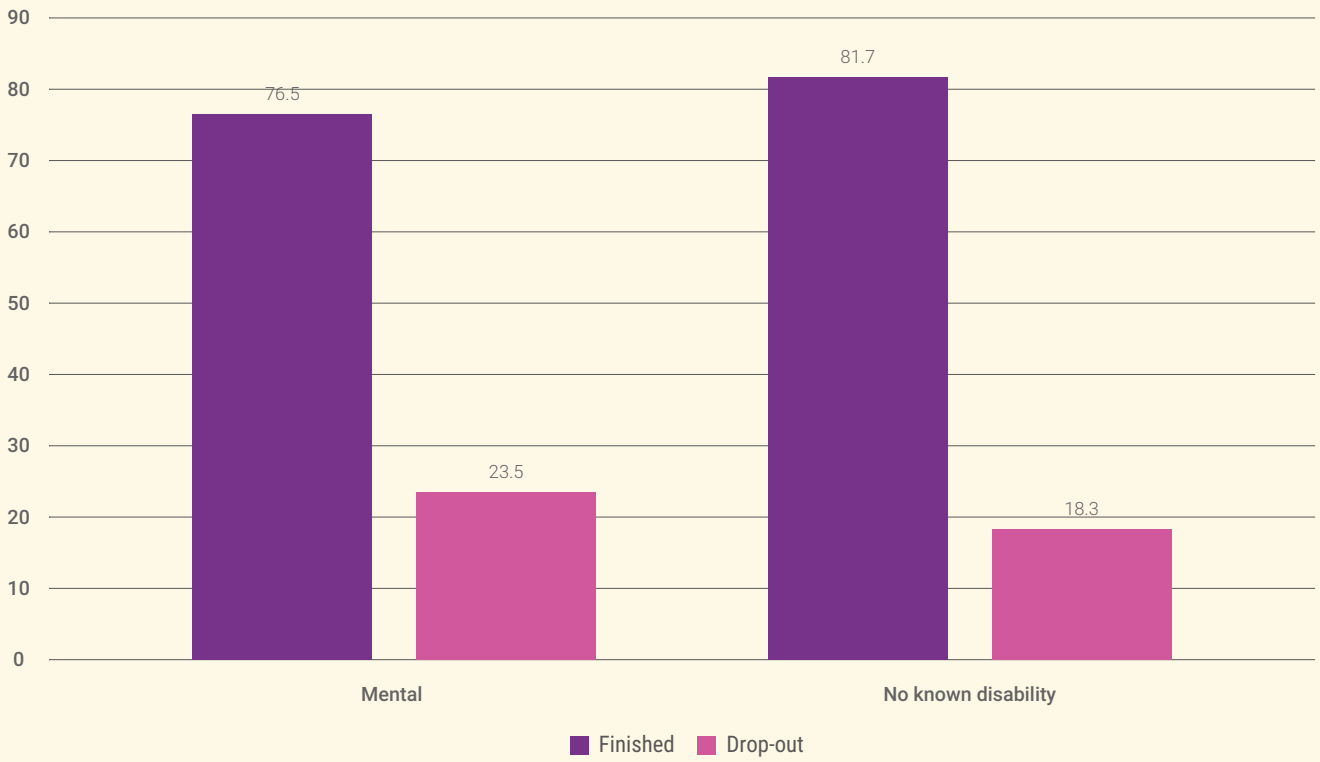
Source: *HESA data*

Figure 17. Percentage of dropouts by ethnicity.

7. We did not find any gender inequalities regarding drop-out among life sciences doctoral students.

8. Following the HESA rounding methodology, we cannot present any percentages based on fewer than 21 individuals.

Figure 18 shows the percentage of students who finished and dropped out by whether they reported having mental disabilities[9]. It is important to highlight that students reported their disabilities in the first year of the PhD programme. Therefore, it does not account for students who received a diagnosis or developed any disability during their studies. Students who self-reported having mental disabilities in the first year of the PhD are more likely to drop out (23.5%) when compared to students who did not report any disabilities.

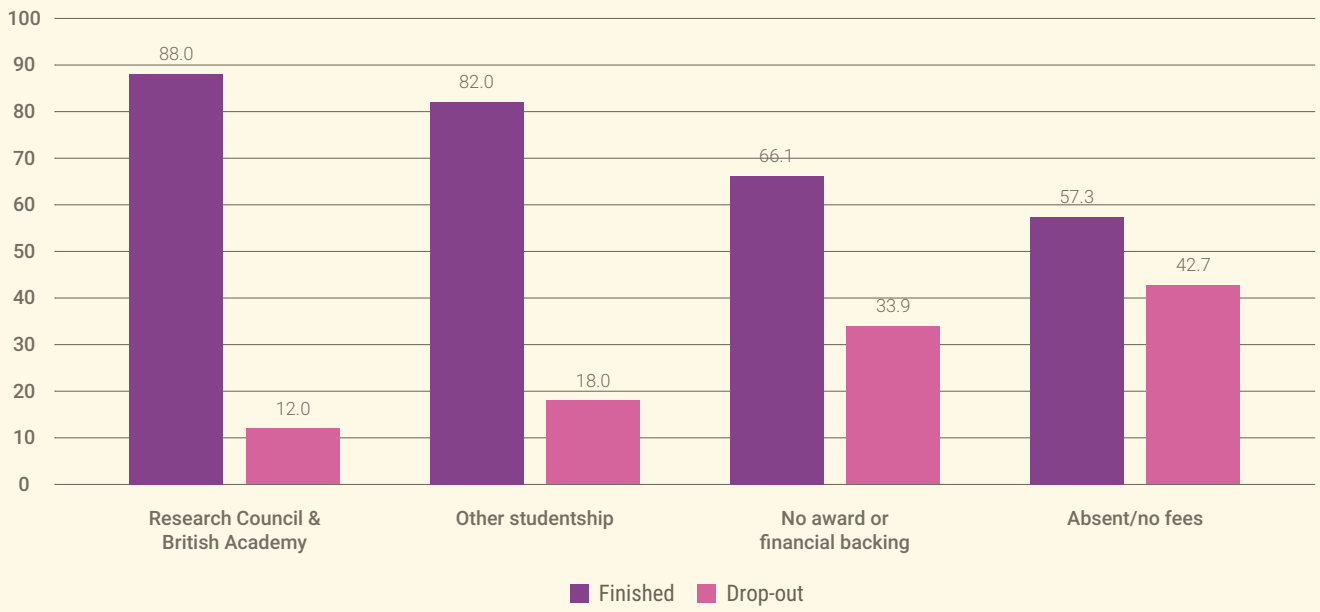


Source: *HESA data*

Figure 18. Percentage of dropouts by self-reported mental disability.

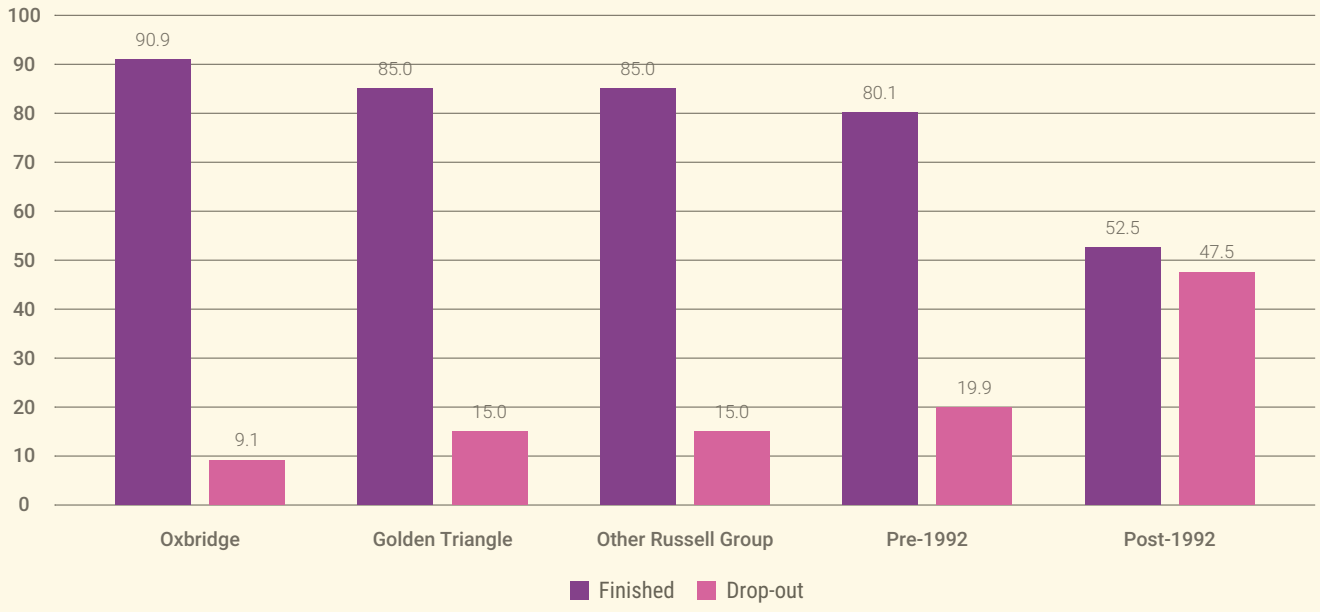
Figure 19 and Figure 20 shows respectively the percentage of dropouts by major source of funding and type of higher education institution. There is a link between funding source and completion rates, with research council funded students most and self-funded students least likely to complete. Similarly, students at Russell Group universities, especially Oxbridge, have a higher completion rate than those at other institutions. As seen in the previous section, there is a strong correlation between the two measures: students from Oxbridge are more likely to be research council funded, while students from post-1992 universities are more likely to be self-funded.

9. Due to the small number of cases, we cannot present the data for students who reported having a physical disability and unknown disability type.



Source: *HESA data*

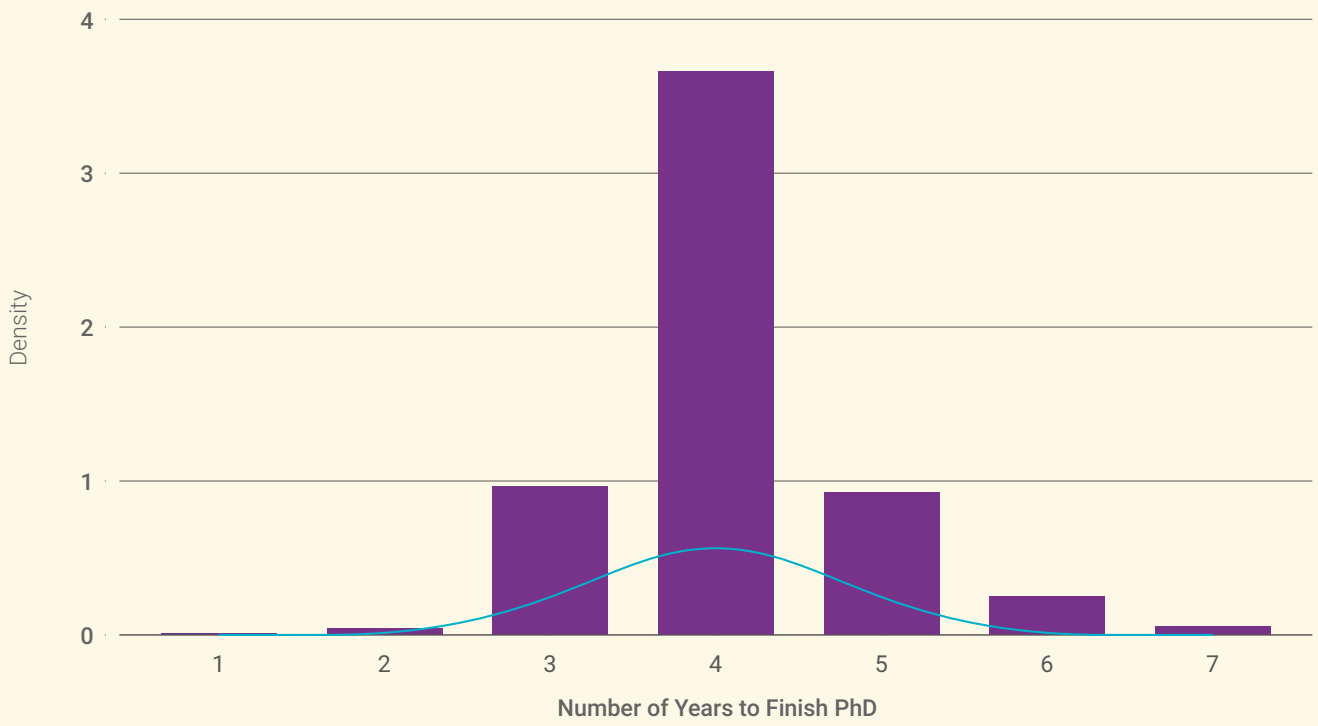
Figure 19. Percentage of dropouts by major source of fees.



Source: *HESA data*

Figure 20. Percentage of dropouts by type of higher education institution.

In this section, for the students who successfully finished their PhD in the life science subjects, we also analyse differences in the number of years. The majority of students finished their doctorate studies in four years (61.8%). 17.4% finished their studies in fewer than four years and 20.8% finished in five years or more (see Figure 21). Our analysis does not show any socioeconomic and gender difference in the number of years to finish the PhD programme. Unfortunately, because of the small number of cases, we could not examine disaggregated ethnic differences. Although a higher percentage of BAME students finished their PhD in 5 years or more (25% compared to 20% of the White students), we cannot point to substantial differences in the number of years to finish the PhD by ethnicity.

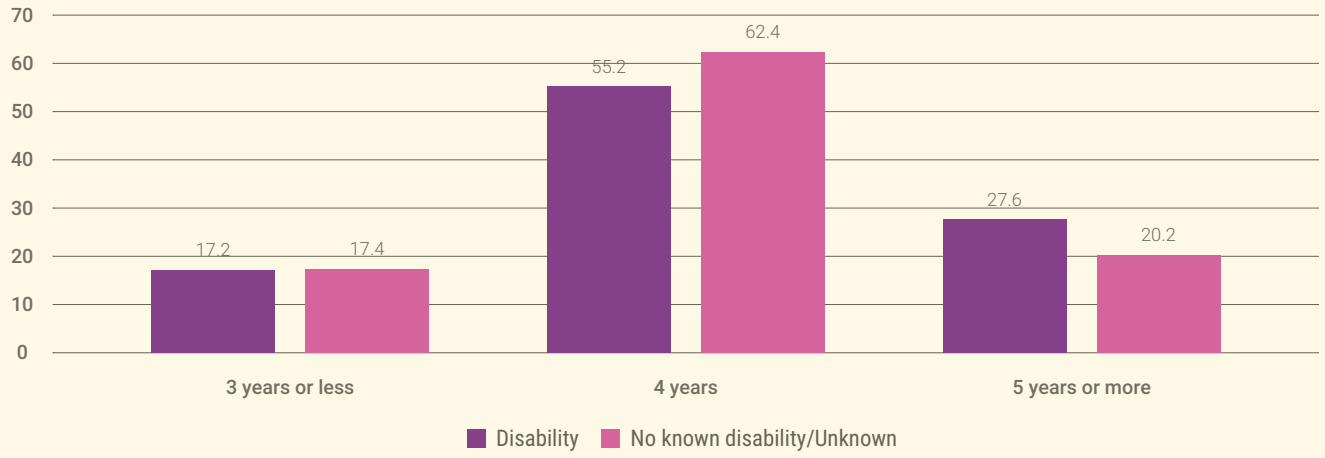


Source: *HESA data*

Figure 21. Histogram for the number of years to finish doctorate for life sciences students.

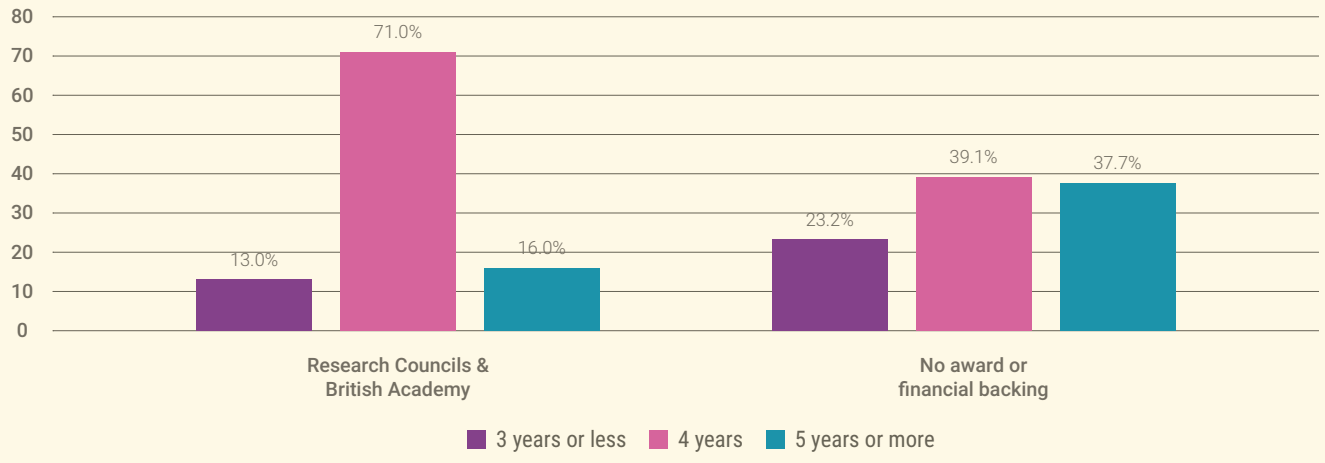
Even though the type of disability might have a different impact on academic trajectories, when we considered the years to finish the PhD programme, we saw few differences between students who self-reported having mental, physical and other disabilities. Therefore, to avoid suppressing information due to the small number of cases, figure 22 shows the number of years to finish the PhD in the life sciences for the aggregated variable for disability. Students who reported having mental, physical or other types of disabilities are more likely to finish their PhD studies in five years when compared to students who did not report any disabilities.

When comparing students' major source of fees, we found some substantial differences in the number of years to finish the PhD studies. For students funded by the research councils, 71.4% finished their postgraduate research degree in four years. For students who did not have any award or financial backing, 39.1% finished in four years and 37.7% finished in five years or more (see Figure 23).



Source: *HESA data*

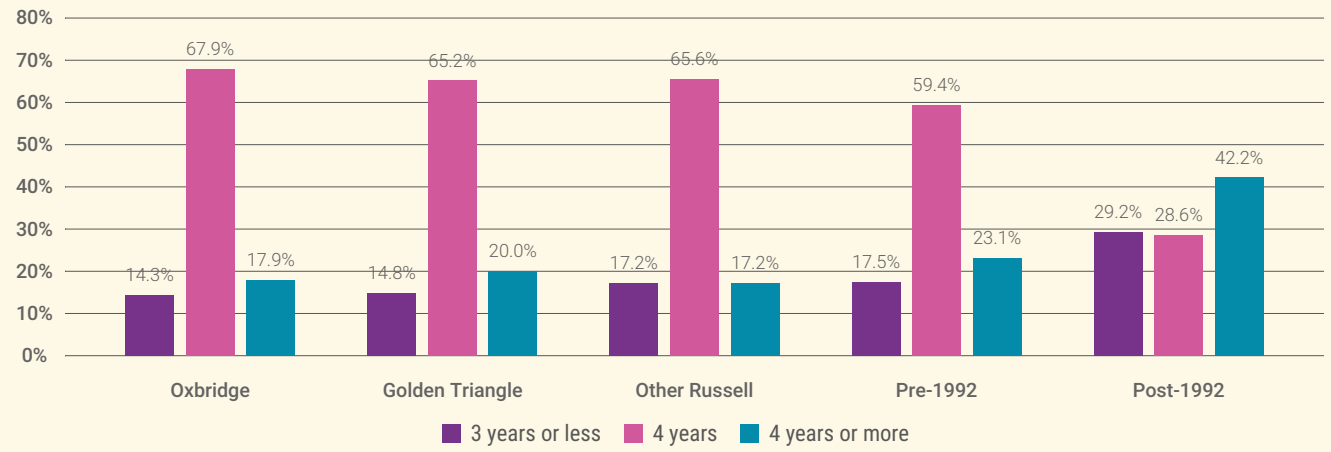
Figure 22. Years to finish doctoral study by whether student reported any type of disability in the first year of the programme.



Source: *HESA data*

Figure 23. Years to finish doctoral studies by major source of fees.

The type of higher education institution is also associated with the number of years to finish the PhD in the life sciences programmes. While the majority of students in Oxbridge, Golden Triangle, Russell Group and Pre-1992 institutions finished their PhD in four years the majority of students in the post-1992 higher education institutions finished their PhD in five years or more (44.1%) (Figure 24), which might be explained by their higher percentage of part-time students.[10]



Source: HESA data

Figure 24. Years to finish doctoral studies by type of higher education institution.

KEY POINTS

The majority of doctoral students in the life sciences finish their PhD in four years.

Around one-fifth of entrants to life sciences PhDs leave their studies without gaining a PhD. While numbers are small Black and Black British students are less likely to finish.

The majority of students who were funded by the research councils finish their PhD in four years or less.

Students in the post-1992 sector and self-funded students are more likely to finish their PhD in five years or more.

10. We are unable to investigate how full-time or part-time study modes impacted on completion times, as over 70% of research students in our dataset qualified from the status of 'writing up'.

7. Destinations of doctoral graduates in the life sciences

To examine outcomes from life sciences doctorates for UK-domiciled graduates, we used the destination dataset, which comprises UK-domiciled doctoral graduates between 2012/2013 and 2016/2017. The data collected by HESA is the most comprehensive longitudinal data on PhD graduates available in the UK, nevertheless, it has several limitations (Hancock, 2021; Hancock et al., 2019). Due to the high amount of missing information, we cannot examine the effect of socioeconomic background (parental occupation and occupation) on life sciences PhD graduates' destinations. Moreover, the data includes information on destination three years after graduation for only a small number of cases. We have therefore, decided to briefly present these results separately, in Appendix C[11] [12].

Figure 25 summarises employment information for the life sciences graduates three months after doctoral completion. About 80% of the graduates in the life sciences doctoral programmes were in professional or managerial occupations. Almost 55.5% of the graduates in life sciences took up employment in the education sector three months after graduation and about 20% were in professional, scientific and technical activities. Moreover, 55.6% were on a fixed-term contract and 39% were on a permanent or open-ended contract after graduation. These results confirm trends found in the Organisation for Economic Co-operation and Development (OECD) countries which show an increase in the number of doctoral degree holders in temporary contracts after graduation and a higher engagement of doctoral graduates from natural sciences and engineering in research after graduation when compared to doctoral graduates from social sciences (Auriol et al., 2013).

11. We explored the intersectionality between gender and ethnicity on the destination of the doctorates graduates in the life sciences. Nevertheless, because of the small number of cases and the report space limitation, we decided not to present them in the report. To summarise, we found some indication that males from minority groups are less likely to in a postdoctoral contract after graduation or employed in the education sector while females from minority groups are less likely to be in a managerial or professional occupations three months after graduation.

12. We examine the frequency distribution for the variables of postdoctoral contract, academic job, occupation and salary by students self-reported disability for doctoral graduates. We found some differences between the type of disability and whether the PhD graduates were in a postdoctoral position and whether they were in a managerial or professional occupation three months after graduation. We cannot present the frequency tables on graduates' destination and type of disability because of the small number of cases (only 6.4% of the doctoral graduates in the life sciences reported having a disability). Consequently, the coefficients were not statistically significant when we included the disaggregated variable for students' disabilities on the regression models.

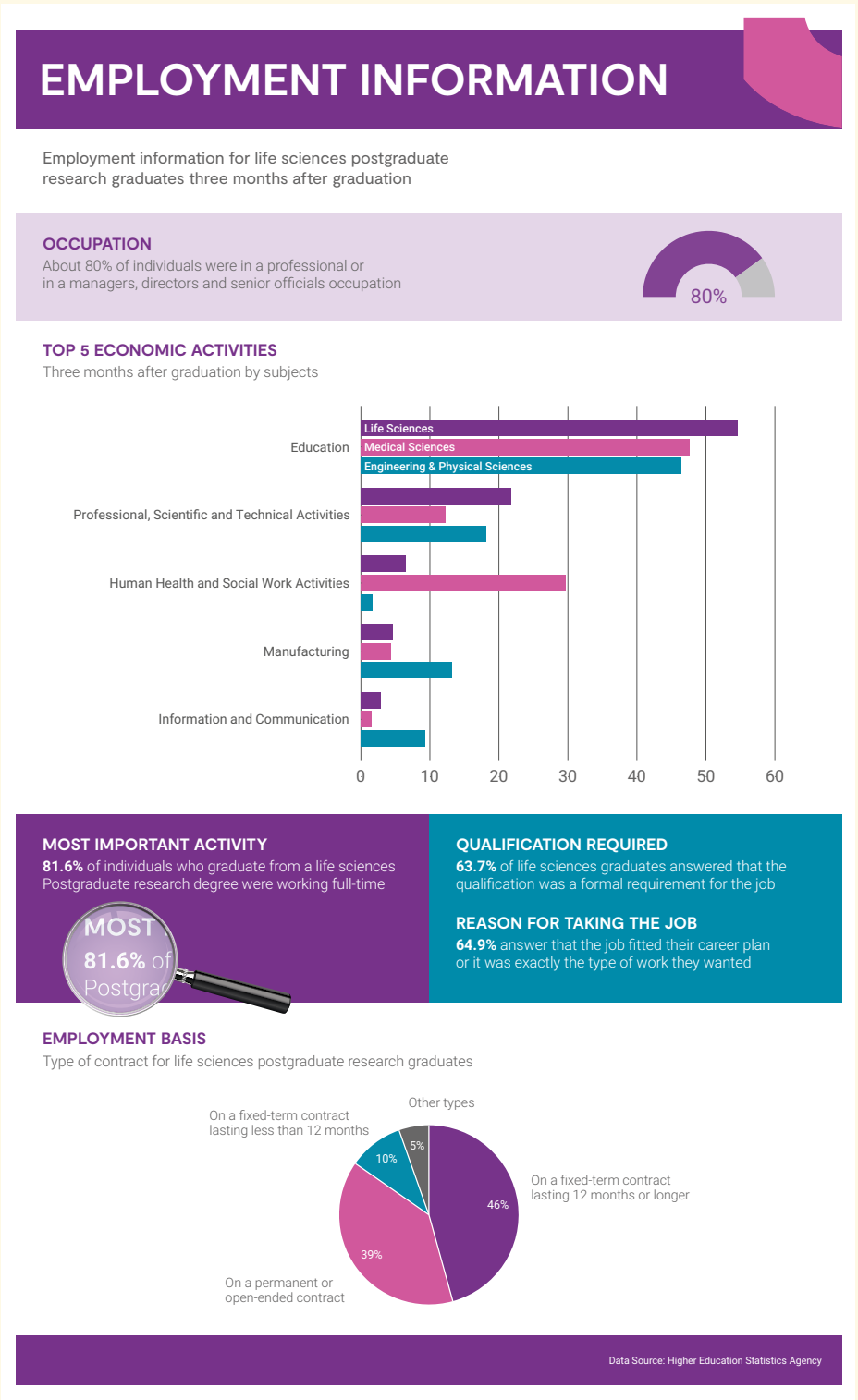


Figure 25. Summary statistics of employment information for postgraduate research graduates in life sciences subjects.

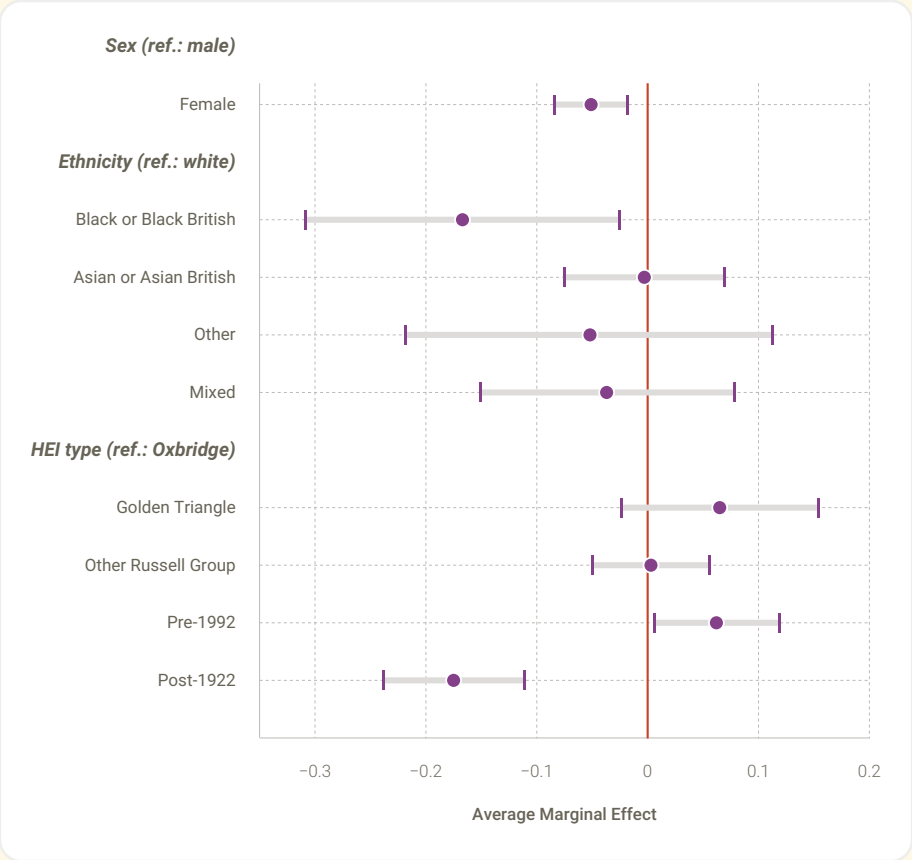
7.1 Academic jobs

Those few studies which examine the destination of doctoral graduates focus on understanding the transition to academic employment (Hauss et al., 2015; Hottenrott & Lawson, 2017; van de Schoot et al., 2012) with little known about transition to industry (Germain-Alamartine et al., 2021; Kyvik & Olsen, 2012). Almost all studies show that departmental and organisation factors have a significant impact on whether doctoral graduates enter the academic labour market, but less focus is placed on graduates' characteristics and socioeconomic background.

Moreover, although there is an established debate on the representation of women in STEM in academia, much less is known about how ethnic minorities' representation in academia might affect the number of ethnic minority postgraduate research students, nor those students' intentions to pursue an academic job after graduation. So far, we have shown that there are race/ethnic inequalities in access to a postgraduate research degree and studentship funding in the life sciences. In this section, we want to contribute to the discussion on minority group representativeness in academia by examining how individuals' characteristics might affect their likelihood to enter an academic job after graduation.

To understand whether individuals' gender, ethnicity, and type of higher education institution of the doctoral programme affect their likelihood of pursuing an academic career after graduation and its employment basis, we use two different variables for academic jobs. The first is an indicator variable for individuals with a postdoctoral contract three months after graduation. This information is derived from graduates' answers regarding their job titles, and it was provided in the dataset. The second variable examines whether individuals are working in a higher education institution, including post-doctorates, three months after graduation, taking into account the type of contract. To determine whether individuals were in an academic job, we created a new variable using occupation and economic activity. For the former, we run a logistic regression model to estimate the probability of having a postdoctoral contract and, for the latter, we run a multinomial logistic regression model to estimate the probability of having an academic position.

Figure 26 shows the AMEs of sex, ethnicity, and institution type of doctoral programme on the predicted probability of having a postdoctoral research contract three months after graduation for life sciences graduates. On average, female individuals have a lower probability of having a postdoctoral research contract compared to male individuals after controlling for ethnicity and higher education institution type of the doctoral programme. Moreover, individuals who declared being Black or Black British are less likely to have a postdoctoral contract when compared to White individuals while there are no statistical differences in the probability of having a postdoctoral research contract between White and 'Other' ethnicities. Last, individuals who earned their postgraduate research degree in a post-1992 higher education institution are less likely to get a postdoctoral contract.



Data Source: *Higher Education Statistics Agency*

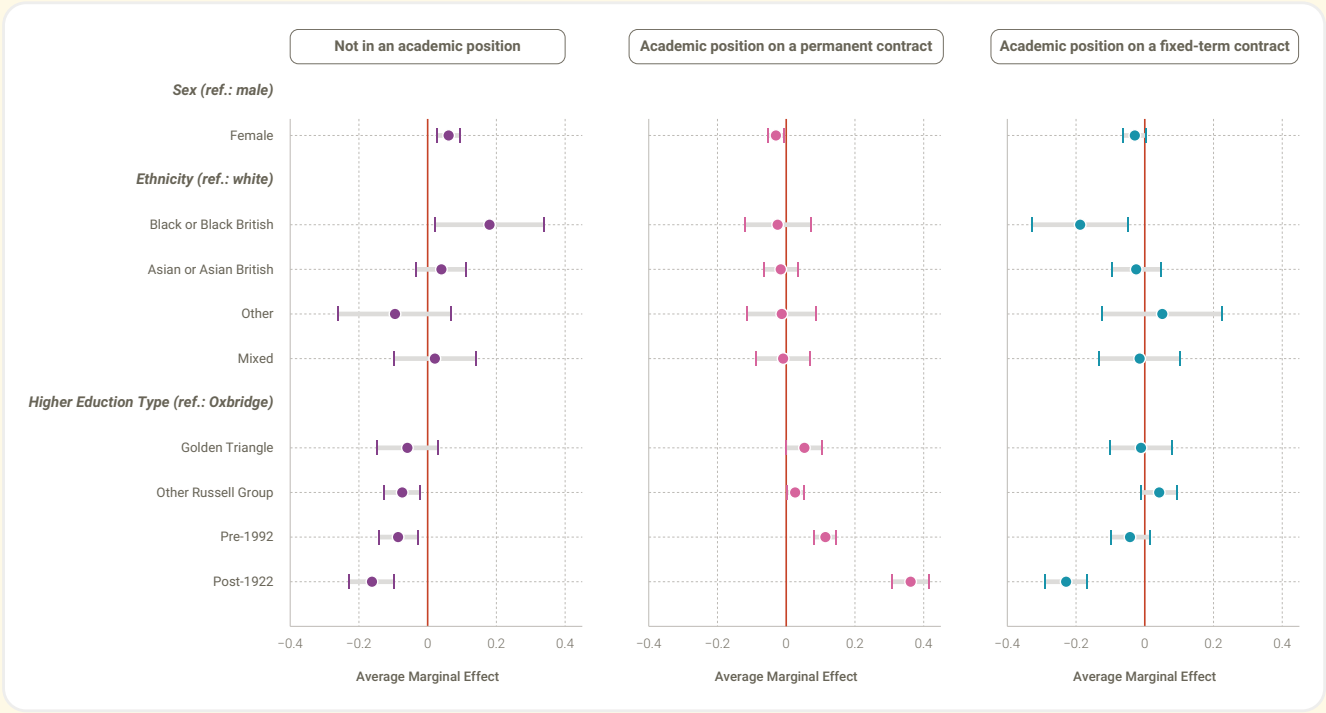
Figure 26. Average marginal effect for the predicted probability of having a postdoctoral contract three months after graduation for life sciences graduates

Figure 27 shows the AMEs for the multinomial logistic regression model on academic position taking into account the type of contract. On average, female life sciences graduates were less likely to remain in academia than male graduates. Moreover, while Asian, Other and Mixed ethnicities show no statistically significant differences compared to White doctoral graduates, Black or Black British graduates have a higher probability of not staying in academia. Lastly, life sciences doctoral graduates from Other Russell Group, pre-1992 and post-1992 are less likely to stay in academia when compared to Oxbridge graduates.

When considering individuals who stayed in academia and have a permanent contract, ethnicity does not have a statistically significant effect. Nevertheless, on average female doctoral graduates in life sciences are less likely to have an academic position on a permanent contract when compared to male graduates. Moreover, graduates from pre-1992 and post-1992 are more likely to stay in academia on a permanent contract when compared to Oxbridge graduates in life sciences. Last, for graduates who

were in an academic position with a fixed-term contract three months after graduation, while there was no statistically significant effect of gender, Black and Black British were less likely to have an academic position on a fixed-term contract when compared to White graduates and post-1992 graduates when compared to Oxbridge doctoral graduates in the life sciences.

The different effects of higher education institution type on the probability of getting an academic job by contract type might be explained by differences in academic trajectories of graduates from Oxbridge and post-1992 institutions. While graduates from post-1992 institutions might pursue more teaching-focused academic jobs immediately after the PhD, graduates from Oxbridge institutions might first pursue a postdoctoral job (where most contracts are fixed-term) and, after, apply for academic jobs in more research-intensive higher education institutions. Nevertheless, further research should investigate differences in academic trajectories of doctoral graduates in the UK by type of higher education institutions.

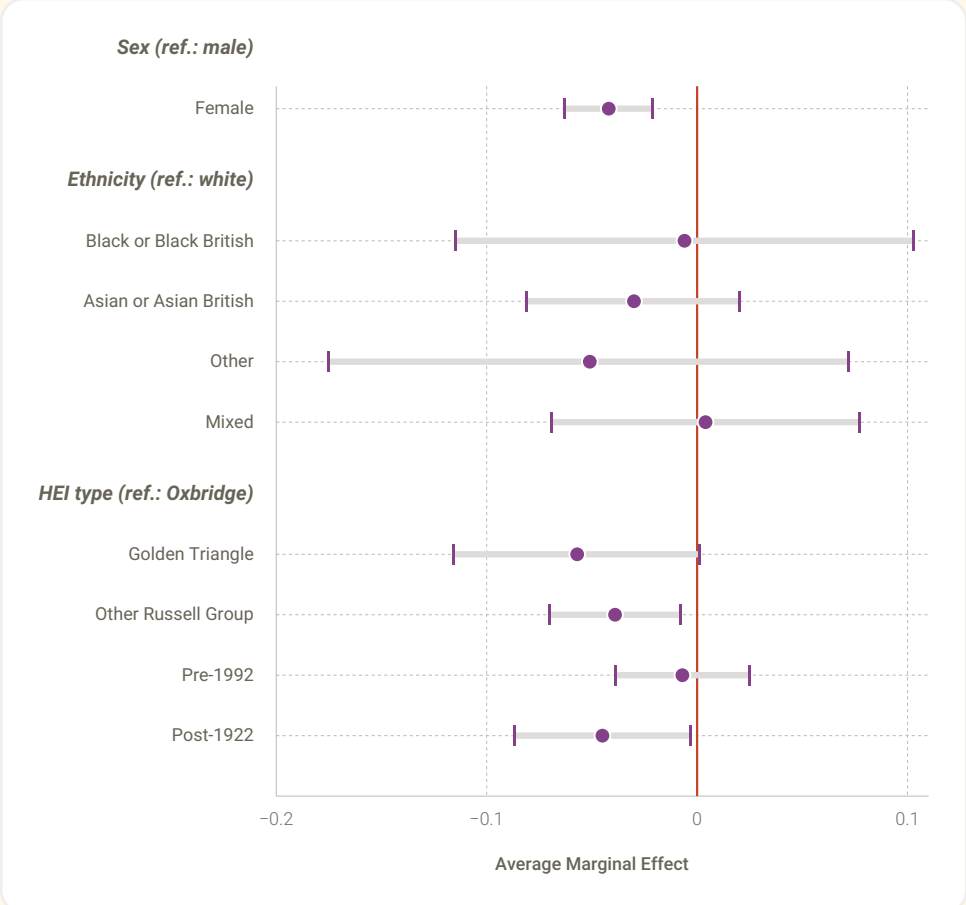


Data Source: *Higher Education Statistics Agency*

Figure 27. Average marginal effects for the predicted probability of having an academic job considering the type of contract three months after graduation for life sciences graduatesOccupation and income

7.2 Occupation and income

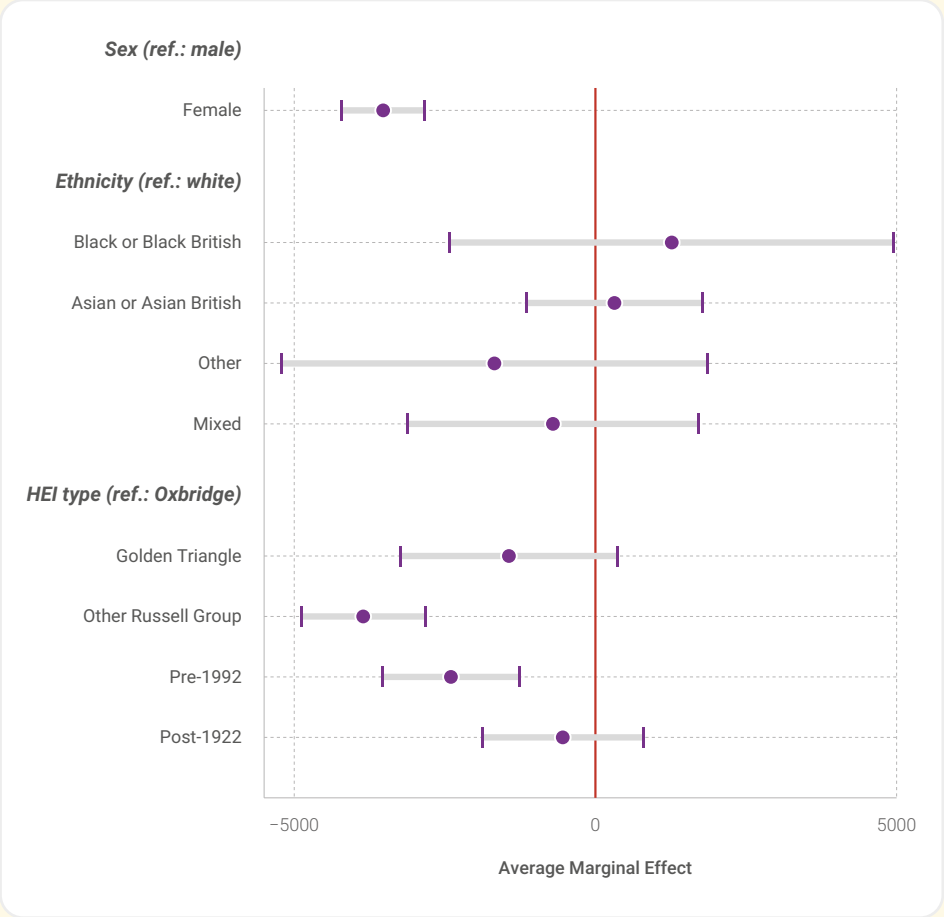
Figure 28 shows the AME for the logistic regression model on the indicator variable for managerial or professional occupation against individuals' sex, ethnicity, and type of higher education institutions of the postgraduate research degree for graduates in the life sciences subjects. After controlling for ethnicity and higher education institutional type, on average women are less likely to occupy managerial or professional occupations compared to men three months after graduation. Moreover, individuals who attend post-1992 higher education institutions are less likely to be in managerial or professional occupations when compared to individuals who attend Oxbridge universities after controlling for individuals' characteristics. Nevertheless, there are no ethnic/race inequalities in the likelihood of having a managerial or professional occupation for doctoral graduates in the life sciences after controlling for sex and high education institution type.



Data Source: *Higher Education Statistics Agency*

Figure 28. Average marginal effect for the predicted probability of being of managerial or professional occupation three months after graduation for graduates in life sciences subjects.

Figure 29 shows the average marginal effects for the linear regression model on the salary against individuals' sex, ethnicity, and type of higher education institutions of the postgraduate research degree for graduates in the life sciences subjects. While there are no ethnic inequalities regarding salary, on average, female graduates earn less than male graduates three months after finishing the postgraduate research degree in life sciences. Moreover, doctoral graduates in the life sciences from Other Russell Group and Pre-1992 higher education institutions earn, on average, less than Oxbridge graduates.



Data Source: *Higher Education Statistics Agency*

Figure 29. Average marginal effects for the average income three months after graduation for graduates in life sciences subjects.

KEY POINTS

The majority of doctoral graduates in the life sciences are employed in the Education sector three months after graduation.

Female doctoral graduates are more likely to be in a non-academic position after graduation when compared to men. Black and Black British doctoral graduates are more likely to be in a non-academic position and less likely to have a fixed-term contract three months after graduation when compared to White graduates.

Institutional differences have an effect on academic trajectories after graduation. Graduates from pre- and post-1992 institutions are more likely to have an academic position with a permanent contract three months after graduation.

Female doctoral graduates in life sciences subjects are less likely to be in a managerial or professional occupation and earn, on average, less than male doctoral graduates.

Doctoral graduates from Other Russell Group and pre-1992 higher education institutions earn, on average, less than doctoral graduates from Oxbridge universities.

8. Discussion

In this final section, we draw out the main findings from our analysis, reflect on what they tell us more broadly about inequalities in the early research career in the life sciences, and consider some potential actions to bring about change.

We wish to begin by acknowledging that many of the findings reported in our analysis confirm earlier findings in two ways. First, researchers and activists of colour have pointed out the stark underrepresentation of Black people in particular among recipients of research council studentships, and also of research council grant funding (Adelaine et al., 2020; Giles et al., 2020; Williams et al., 2019). We hope that UKRI and BBSRC will honour their commitment to engage with Leading Routes, the #KnowledgeisPower collective and others who have repeatedly raised these issues to call for a process of constructive change. The Office for Students and Research England initiative to widen participation in postgraduate research for Black, Asian and minority ethnic groups is a positive step. Finding a way for the research councils to formally associate with this initiative, or to set up their own will help to go further in addressing the striking underrepresentation of Black people among research council studentship holders and postdoctoral staff, including in the life sciences.

Second, where there is previous research to draw on, many of the patterns we report here for the life sciences are similar to patterns seen in postgraduate research participation overall. Some of the factors and processes which influence inequalities in life sciences early research careers transcend any one discipline and hence cannot be entirely solved from within the field itself. Indeed, some of the grander structural influences, such as institutional stratification of universities and regional economic inequalities within the UK are not easily addressed by UKRI and are instead matters for national government. However, the nature of different disciplines, variations in how they are organised and the inequalities which affect them most all mean that the road to greater equality in early career research must pass through the disciplines.

In our view, there are five key messages for BBSRC and the life sciences community arising from our analysis. Our analysis points to differences in the **structure of opportunities available** for progression into life sciences doctoral study. When comparing those beginning a PhD with their equally qualified peers who did not, it is clear that women, students from most minority ethnic groups and from less socio-economically advantaged backgrounds are underrepresented. For some groups, particularly Black graduates, this underrepresentation is stark. It contrasts with the representation of graduates by ethnicity among those life sciences graduates who move on to postgraduate clinical training (e.g., medicine as a second undergraduate degree). As we show in Appendix A, Black and South Asian groups have higher levels of representation here, although the overall numbers are relatively small. We also show that there is a strong connection between the institutional location of potential life sciences PhDs at first-degree level and the likelihood of making an immediate transition to a PhD. The institutions with lower proportions going on to a doctorate are also the institutions with

the highest proportion of underrepresented students. Coupled with the relative lack of institutional mobility we show between first-degree and PhD, this strongly suggests that DTPs need to look outside their usual institutional recruiting grounds in order to widen participation.[13] As has been the case for undergraduate widening participation, there is a case for further outreach from DTPs, especially to post-1992 universities. These institutions are much less likely to host DTPs/CTPs but represent half of all life sciences first-degree graduates.

A related theme is the **concentration of life sciences activity institutionally and geographically**. This is a complex issue, since there are arguments in favour of clustering research rather than dispersing it, particularly in the natural sciences. Such rationale lie behind initiatives like the Crick Institute and Cambridge's Silicon Fen. Nevertheless, patterns of concentration in the life sciences reflect national patterns, with an overall concentration in London and the South East (we note that BBSRC DTPs are distributed throughout the UK though). While moving institution/sector between first-degree and PhD is relatively limited, that movement which takes place points to a 'brain drain' from the devolved nations and other parts of England into London and the East of England.

Going beyond access, through our analysis of the progression and outcomes datasets we identify what looks like **'U-shaped' inequality across the life sciences early career**. Access to doctoral study is unequal. Once a doctoral programme is entered, progression through the programme shows few substantial inequalities in completion between different groups – with the notable exception that the relatively small number of Black PhD students are less likely to complete the programme. However, we see inequalities re-appear in doctoral destinations. Women and Black doctoral graduates are less likely to enter academic jobs after their PhD, according to our data. From the data we have, we cannot tell why there might be such differences. Nevertheless, there is a clear need for action, especially on ethnicity. If there are lower than expected numbers of Black graduates entering life sciences PhDs ***and*** Black doctoral graduates are less likely to enter an academic job, then as well as acting on access there is a need to do something to reverse the post-doctoral situation.

There are different **options for action to address the issues raised** in this report. We would expect that action across several areas and by a range of different groups is needed. Some actions may be beneficial across the different inequalities identified: better targeting first-degree graduates in the life sciences in post-1992 universities, for instance, would help address race/ethnic and socio-economic inequalities as well as potentially ameliorating regional differences. Actions may have a different balance of risk and reward. 'Outreach' by DTPs is fairly straightforward but might not make significant inroads to the inequalities identified. Conversely, adopting quotas for doctoral or postdoctoral funding for underrepresented groups could be challenging, but has been shown to lead to dramatic change in other countries. In Brazil, for example, the Quota Law, implemented in 2016, assigned 50% of the places in public funded higher education institutions to students from Black, mixed-race, or indigenous backgrounds who studied in public funded secondary schools. A recent report on one of the most prestigious higher education institutions in the country showed that the number of undergraduate

13. At least to address race/ethnic and socio-economic inequalities. Gender differences do not seem to relate to institutional stratification in the same way.

students from minority background almost doubled after the policy was implemented (Paula et al., 2021). While the UK and Brazil have very different demographics, history and higher education systems, the example shows that radical actions can lead to change. Many BBSRC DTPs are already taking forward their own actions in doctoral access.

We know, through the wider project of which this report forms a part, that there is commitment and determination to address equality, diversity and inclusion in the life sciences among DTPs/CTPs. Other funders are introducing schemes too, such as the Wellcome Sanger Institute (Cambridge) and its postdoctoral scheme for Black heritage scholars. Positive action schemes like this providing dedicated awards for students from underrepresented groups will be an important means of supporting early career researchers at PhD and postdoctoral levels. Careful co-ordination of schemes is needed across and beyond the life sciences research community to facilitate maximum impact for such schemes. Experience of previous initiatives is that they tend to be somewhat atomised and unconnected. This makes systematic evaluation of impact much more difficult to achieve. Putting in place a mechanism to connect institutions and initiatives, perhaps through BBSRC, could help in this regard.

Examining selection practices and criteria is another potential means of addressing underrepresentation. Research on equity in graduate admissions in the USA shows that the adoption of particular notions of 'academic pedigree' as a sign of merit can have the effect of excluding underrepresented groups from positions at the shortlisting stage (Posselt, 2016). Examples might include the use of research experience as an indicator of ability (rather than of prior ***opportunity***) and of first-degree university as a proxy for ability. In case study research, US institutions which successfully widened access to their graduate school shared a common approach: revision of their selection criteria and practices (Posselt, 2016, 2020).

Finally, our experience of conducting the research and analysis for this report has re-confirmed the **need for more and better-quality data about the research career life course**. Compared to key comparator countries such as Germany and the USA, we lack rich longitudinal data about the postdoctoral research career (Hancock et al., 2019). Tracking PhD graduates is limited to their 'first destination' 6 – 18 months after completion, with only a small number tracked beyond that. Most of the data we have is factual, with little systematic data on motivations, career progression and change, and so on. Similarly, data about postgraduate students, including PhD students, is less extensive than for undergraduates, especially in relation to background characteristics and prior academic experiences. Connecting together individual students' records across different qualifications as they leave and re-enter higher education is possible, but only at some expense to researchers. Statutory bodies such as UKRI have a role to play here in prioritising the collection and collation of data, especially for EDI characteristics.

We hope that the evidence presented in this report will contribute to both discussion and action to improve representation and inclusion in the life sciences early career.

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Appendices

Appendix A. First-degree graduates who followed a clinical route immediately after graduation

Following the research performed by Garrud (2011), this appendix examines the differences by EDI characteristics between first-degree graduates in life sciences by whether they pursued a ***clinical*** route, students who pursued a bachelor's in medicine & dentistry or subjects allied to medicine immediately after graduation; or an ***academic*** route[14], students who pursued a postgraduate research degree in any field of study immediately after. Of the 126,925 first-degree graduates in life science between 2012/2013 and 2016/2017, about 1.0% (N = 1,410) pursued a clinical route and about 4.6% (N = 5,805) pursued an academic route.

Figure 30 shows the distribution of first-degree graduates in life sciences by route and sex. As shown in the main report, the majority of graduates in life sciences degrees are female. Nevertheless, we found a higher percentage of female first-degree graduates among those who pursued a clinical route (58.8%) than an academic route (53.5%).

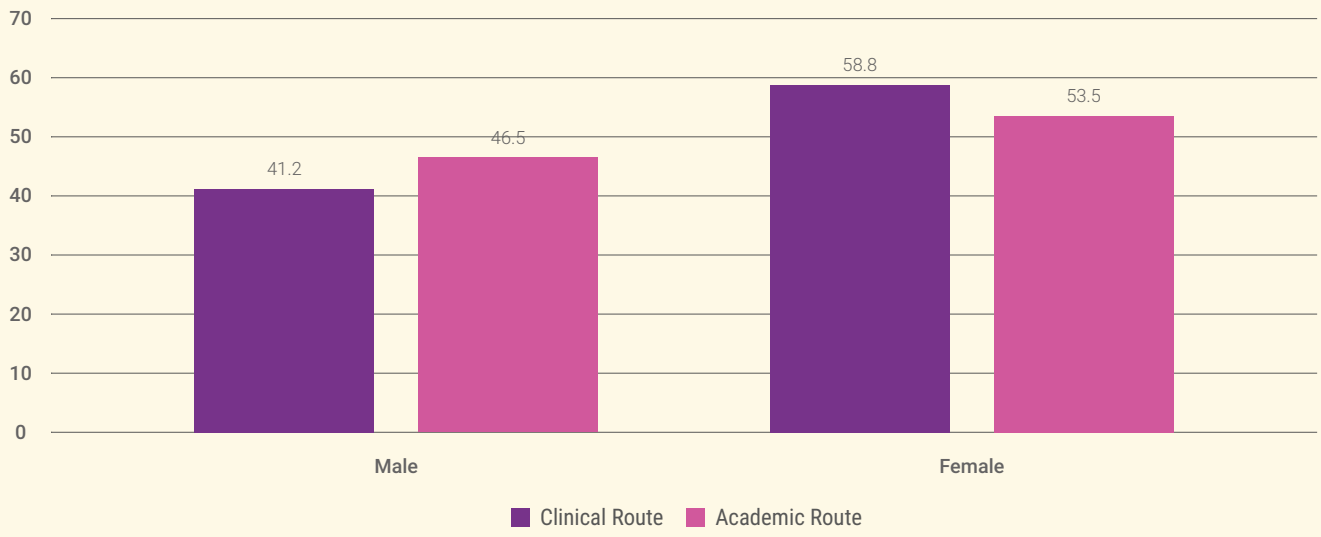
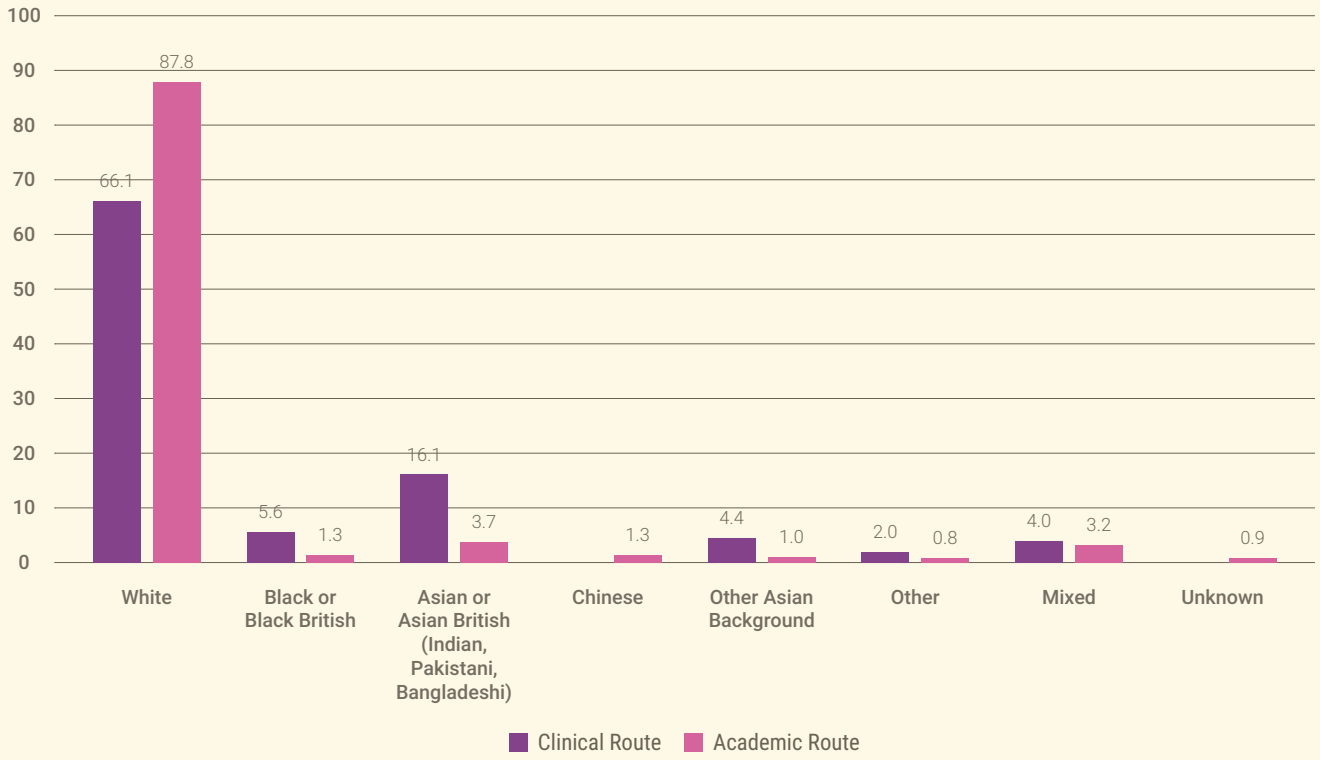


Figure 30. Percentage of first-degree graduates in the Life Science who pursue a clinical route by sex

14. It is important to highlight that PGR group in this comparison is different from the PGR group analysed throughout the report (PGR students in the Life Science doctoral programmes).

Figure 31 shows the distribution for the first-degree graduates in life sciences who pursued a clinical or an academic route by ethnicity. First-degree graduates from minority ethnic groups are more likely to pursue a clinical than an academic route, corroborating the findings from Garrud (2011). Nonetheless, we found that, in addition to a higher percentage of Black or Black British first-degree graduates (5.6%), the clinical route seems to be more attractive to first-degree graduates from Asian or Asian British backgrounds (16.1% against 3.7% in the academic route). We also found a negligible percentage of students from Chinese backgrounds following a clinical route.



Note: the percentage of students who declared being Chinese or from a mixed background pursuing a clinical route had to be omitted due to the small number of cases

Figure 31. Percentage of first-degree graduates in the Life Science by route and ethnicity

Regarding students' disability and socioeconomic background, we found little difference between first-degree graduates pursuing a clinical or academic route (respectively, Figure 32 and Figure 33).

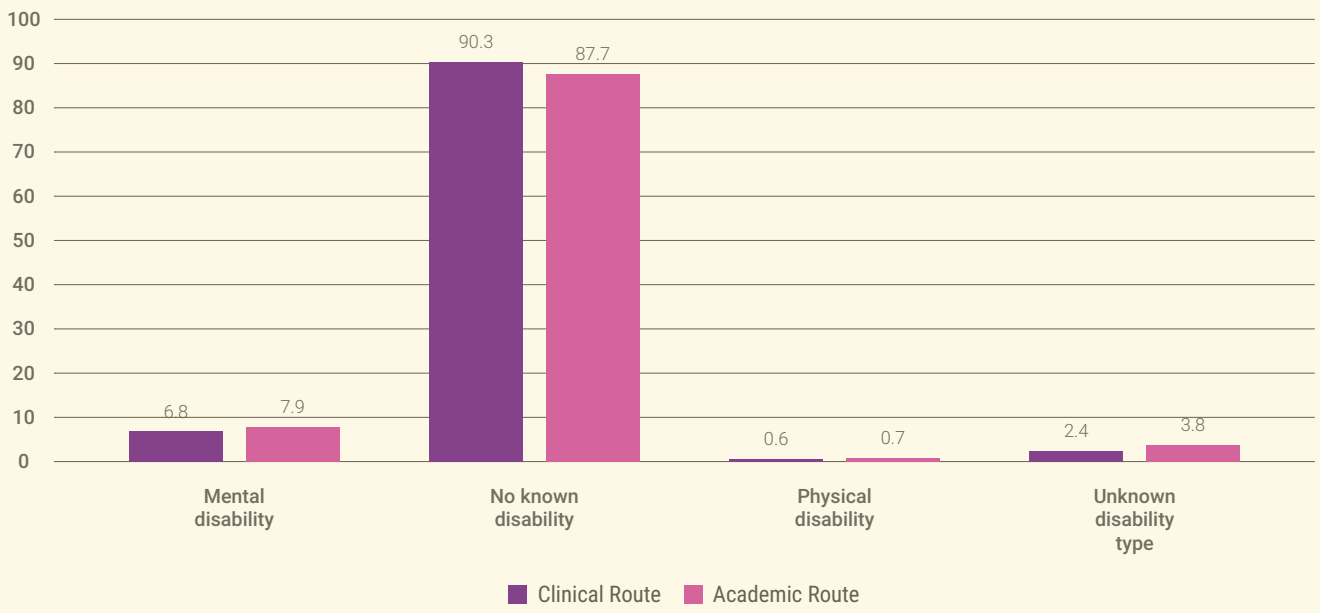


Figure 32. Percentage of first-degree graduates in the life science by route and disability

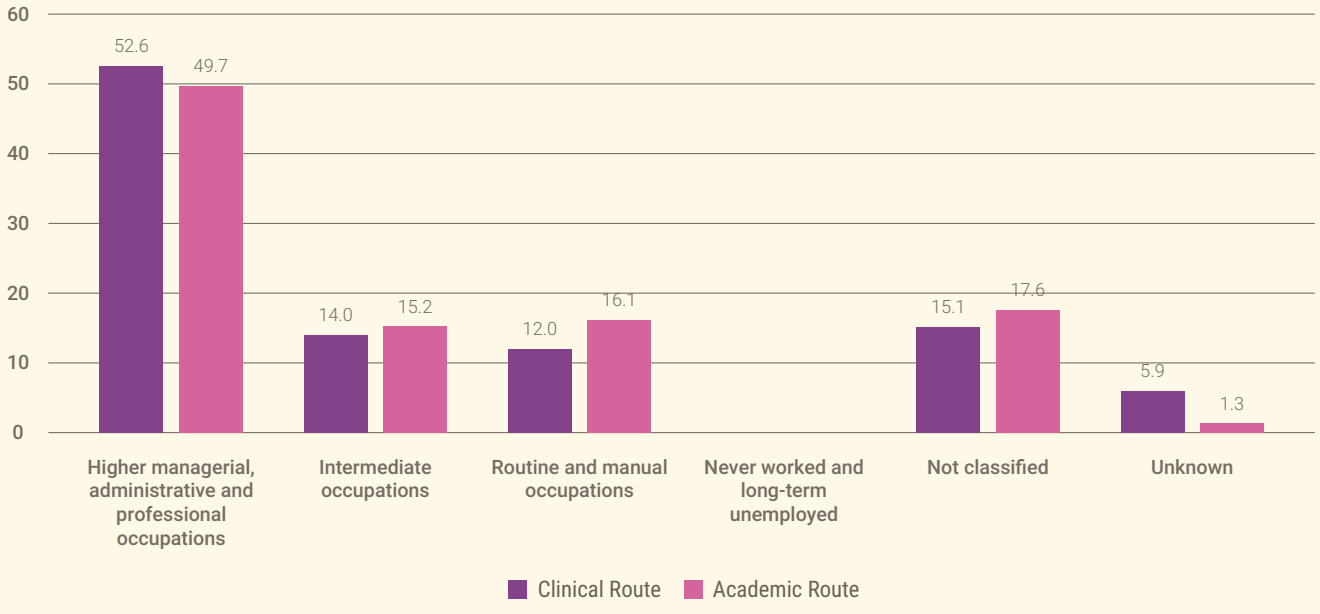


Figure 33. Percentage of first-degree graduates in the life science by route and socioeconomic background

Appendix B: Lead organisations and full partners of BBSRC DTPs

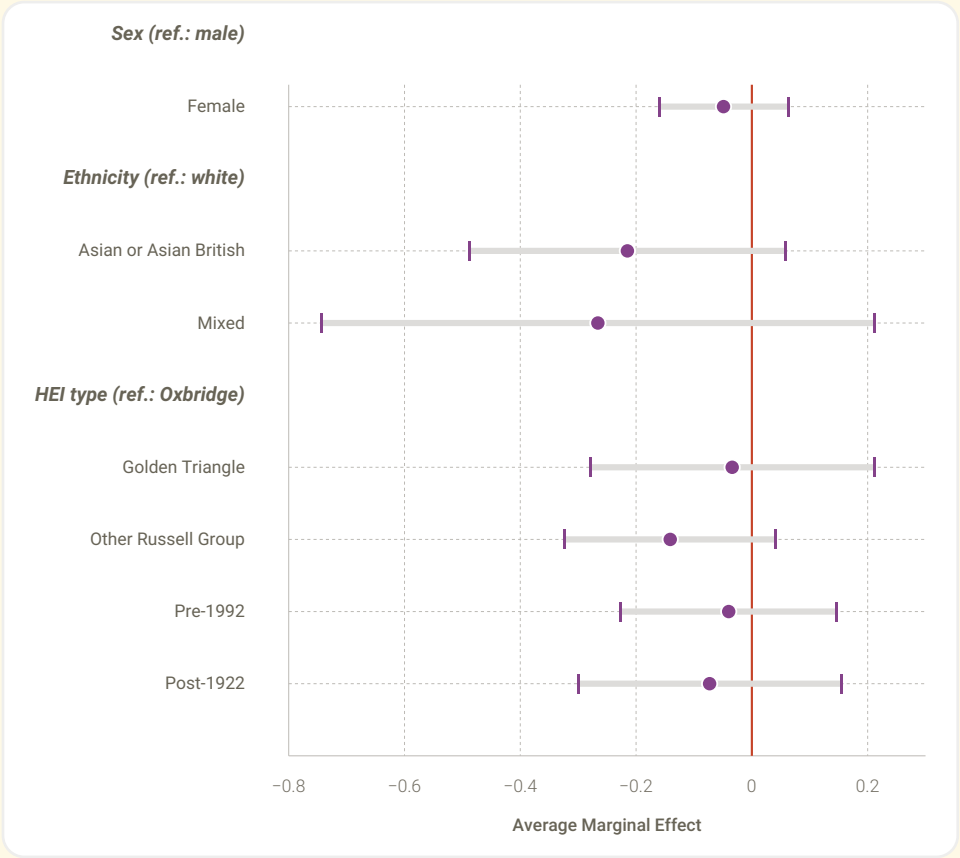
Lead Organisation	Full Partners
University College London	Birkbeck University Kings College London LSHTM QMUL Royal Holloway of London Royal Veterinary College University of Greenwich
University of Oxford	Oxford Brookes University The Pirbright Institute Diamond Light Source ISIS Neutron and Muon Source Research Complex Harwell STFC Central Laser Facility The Rosalind Franklin Institute
University of Warwick	University of Birmingham University of Leicester Aston University Harper Adams University
University of Liverpool	Newcastle University Durham University
The University of Manchester	
University of Bristol	University of Bath Cardiff University University of Exeter Rothamsted Research
John Innes Centre	University of East Anglia Quadram Institute Bioscience Earlham Institute The Sainsbury Laboratory

University of Edinburgh	University of Aberdeen University of Dundee University of St Andrews University of Stirling Scotland's Rural College IBioIC James Hutton Institute Moredun Research Institute
University of Reading	Aberystwyth University Brunel University London Cranfield University Queens University Belfast University of Surrey
University of Southampton	University of Kent University of Sussex University of Portsmouth NIAB-EMR
University of Nottingham	Nottingham Trent University National Biofilm Innovation Centre
University of Leeds	University of York University of Sheffield

Appendix C: Destination three years after graduation

The dataset includes information on destination three years after graduation for only 330 postgraduate research graduates in the life sciences. Moreover, the dataset includes a small number of individuals who were declared to be Black and Black British and Other ethnic backgrounds. Therefore, we cannot examine race inequalities for destination three years after graduation.

About 90% of the postgraduate research degree graduates in the life sciences were in a professional or managers, directors, and senior official occupation. Figure 34 shows the average marginal effects for the logistic model on the indicator model for managerial or professional occupation. The model did not find any statistically significant effect of individuals' characteristics and type of higher education institution of the doctoral programme on occupation.



Data Source: *Higher Education Statistics Agency*

Notes: The categories for Black or Black British and Other ethnic backgrounds are omitted due to the small number of cases.

Figure 34. Average marginal effect for the predicted probability of being of managerial or professional occupation three years after graduation for graduates in life sciences subjects.

Most graduates continue in the Education sector three years after graduation (50%), followed by professional, scientific, and technical activities (26%) (see Figure 35).

Moreover, the majority of graduates are on a permanent or open-ended contract after graduation (62%) (see Figure 36).

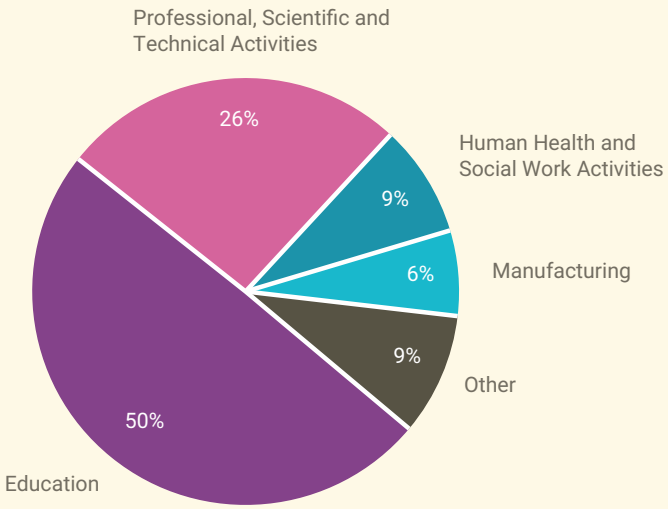


Figure 35. Top economic activities three years after graduation for life sciences postgraduate research graduates.

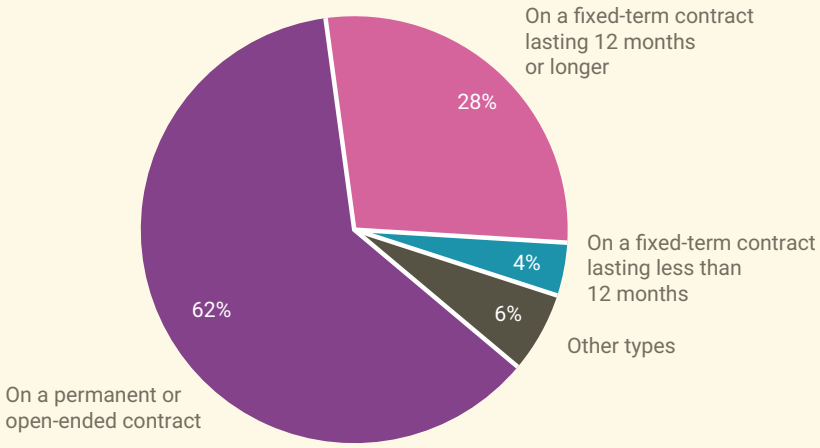
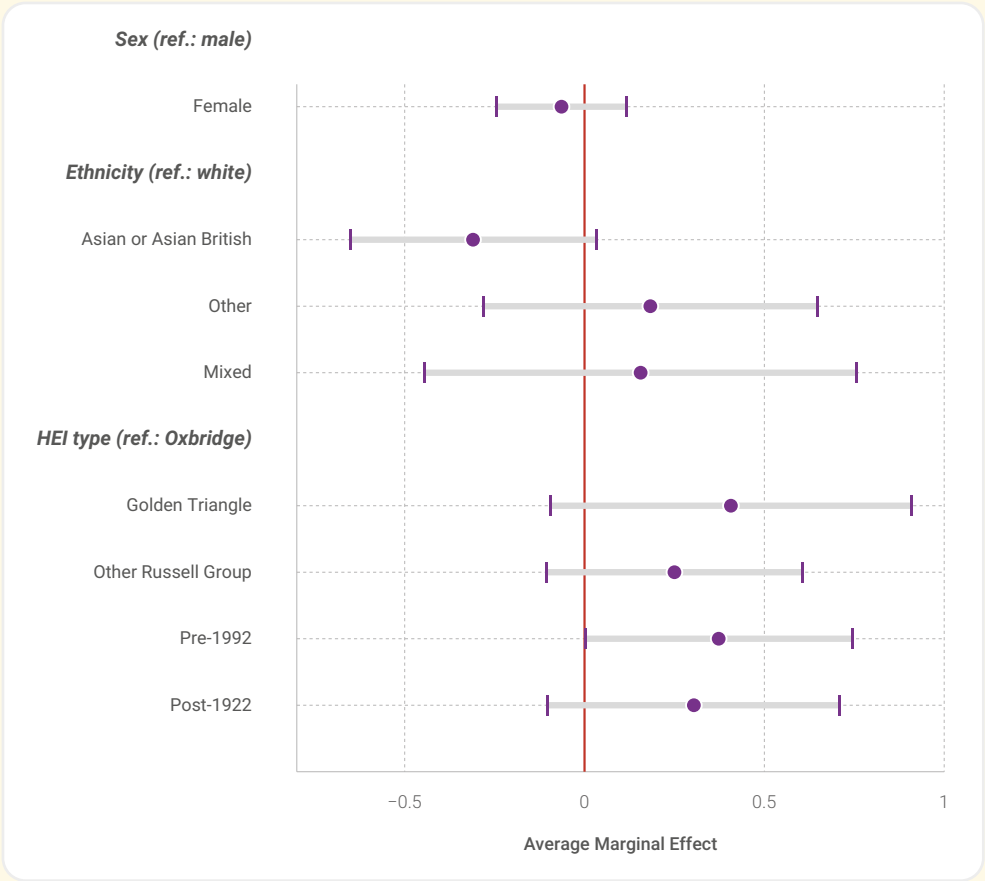


Figure 36. Type of contract activities three years after graduation for life sciences postgraduate research graduates.

Figure 37 shows the average marginal effects for the logistic model on the indicator variable for an academic job. There was no statistically significant difference in the probability of having an academic job three years after graduation by individuals' characteristics and type of higher education institution of the postgraduate research degree.



Data Source: *Higher Education Statistics Agency*

Figure 37. Average marginal effects for the predicted probability of having an academic job three years after graduation for life sciences graduates.