REF 2021- Analysis of inclusion for submission, representation in outputs attribution and scoring

Contents

Summary

1. REF 2021 required that all eligible staff with significant responsibility for research were included in submissions, and that each submitted staff member had between one and five research outputs attributed to them within the submission. Each output was scored independently by the expert panels. This analysis investigates whether there were any differences in **inclusion within submissions**, the **number of outputs attributed** to an individual, and **output scores** that were associated with equality-related, and other characteristics.

2. There were negative impacts observed for the likelihood of submission for some groups, including at whole exercise level and across some or all of the main panels. This included significant effects for Black, female and disabled staff. When considering the number of attributed outputs, these groups were again negatively impacted at exercise, and/or at main panel level.

3. Whilst no difference was detected on scoring at whole exercise level, there was wide variability when focusing on the different units of assessment (UOAs). However, at main panel level two significant differences were found when comparing submissions made by female compared to male researchers.

4. The aggregated outcomes at whole exercise and main panel level in part reflect the variability observed in effects across individual UOAs for different characteristics. However, the analysis undertaken for this study does not provide an insight into the cause of the negative effects observed. Evidence from related analyses and feedback from institutions suggests that the outcomes observed here reflect entrenched issues with inequality and under-representation that feed in multiple ways into the submission and assessment processes for REF.

Introduction

5. The Research Excellence Framework (REF) is the system for assessing research in UK higher education institutions (HEIs). It was conducted in 2014 and 2021 and replaced the previous Research Assessment Exercises (RAE).

6. REF 2021 was conducted jointly by Research England (RE), the Scottish Funding Council (SFC), the Higher Education Funding Council for Wales (HEFCW) and the Department for the Economy, Northern Ireland (DfE NI). The REF is managed by the REF team, based at RE, on behalf of the four UK higher education funding bodies, and is overseen by the REF Steering Group, consisting of representatives of the four funding bodies.

7. The results of REF 2021 were published in May 2022. The four funding bodies are committed to supporting and promoting equality, diversity and inclusion (EDI) in research careers, and strongly encouraged transparency and fairness in the decisions made by institutions to represent the excellent work of all their staff with significant responsibility for research in submissions. An Equality and Diversity Advisory Panel (EDAP) was established to advise the funding bodies, the REF team and the REF panels, on the development, implementation and evaluation of the full range of measures to promote equality and diversity in the REF.

8. As part of the funding bodies' commitment, and as set out in the 'Guidance on submissions' (REF 2019/01), analyses have been undertaken to examine equality impacts in relation to the REF. This report brings together three sets of analysis, examining how protected and other personal characteristics are related to different aspects of the assessment process:

    a) the submitted population, examining which staff were identified as having significant responsibility for research, out of the pool of all staff meeting the eligibility criteria for REF 2021
    b) the number of outputs a staff member had attributed to them in the submitted returns
    c) the assessed quality of outputs

9. The REF is a process of expert review, carried out by expert panels for each of the 34 subject-based units of assessment (UOAs), under the guidance of four main panels.[1] Expert panels are made up of senior academics, international members, and research users. For each submission, three distinct elements are assessed: the quality of **outputs** (e.g. publications, performances, exhibitions), their **impact** beyond academia, and the **environment** that supports research.

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[1] For further detail on the assessment panels, see: https://www.ref.ac.uk/panels/what-is-the-role-of-expert-panels/

10. Characteristics examined through the analyses presented in this report are mostly those protected through UK legislation (Equality Act 2010), as well as whether an individual met the definition of an early career researcher (ECR), and/or had taken parental leave within the previous year. These characteristics are primarily investigated at whole exercise and main panel level.

11. This report forms part of a number of documents that together are intended to provide a comprehensive evaluation of REF 2021 and inform policy development for future exercises.

Role of EDAP

12. Throughout the development and operation of REF 2021 the funding bodies, REF team and the assessment panels relied on advice from the Equality and Diversity Advisory Panel (EDAP).[2] This advisory panel provided advice on matters relating to equality, diversity and inclusion in the exercise. EDAP advised on measures to increase the representativeness of the expert panels, and their advice was central in the development of the guidance and criteria to ensure equality and diversity considerations were recognised in all elements of submissions and assessment. EDAP also provided the panels with advice on the People and Culture section of Environment statements.

Background to the submission of staff and outputs in REF 2021

13. There were several significant changes to the way that staff and outputs were submitted into REF 2021 in comparison with previous exercises. In REF 2021, institutions were required to submit all eligible staff with significant responsibility for research, in contrast to the selective submission approach seen in REF 2014 and previous RAEs. For REF 2021, eligibility was determined primarily through contractual status (those on 'research only' or 'teaching and research' contracts), and where this identified a wider group of staff within the institution than were employed with a significant responsibility for research, the institution could run a process to identify which staff among the eligible pool had significant responsibility for research. HEIs were required to document their processes for identifying staff for submission in a code of practice.[3]

14. In contrast to the REF 2014 requirement to submit a specific number of outputs per submitted staff member, staff and outputs were decoupled in REF 2021. This meant that institutions were required to return a set number of outputs based on the total

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[2] For further details on EDAP and its work, see https://www.ref.ac.uk/equality-and-diversity/
[3] For further detail please see https://www.ref.ac.uk/publications-and-reports/guidance-on-codes-of-practice-201903/. EDAP's final report on codes of practice submitted to REF 2021 can be found here https://www.ref.ac.uk/publications-and-reports/edap-codes-of-practice-in-ref-2021-report/

full-time equivalent (FTE) of staff returned within each unit, with a minimum of one and maximum of five outputs attributed to any one staff member. The total number of outputs required was determined by multiplying the FTE of submitted staff by 2.5 (for example, a unit with an FTE of 10 would have an output requirement of 25).

15. It was recognised that that some individual researchers may have experienced equalities-related circumstances during the REF period which had an exceptional effect on their ability to work productively throughout the assessment period, including where this meant that the individual was not able to produce an output during the assessment period. With the advice of EDAP, processes were implemented to allow HEIs to request that the minimum of one output requirement be removed for individuals disclosing such circumstances. Where a cumulative effect of individual staff circumstances affected a unit's overall output pool, the submitting HEI was able to request that their overall output requirement be reduced[4].

16. The decisions around which outputs to include in submissions and how many outputs were attributed to submitted staff were taken by submitting institutions, in line with documented processes set out in their codes of practice. The submission requirements were set out in the 'Guidance on Submissions'[5].

Background to the assessment of outputs in REF 2021

17. A major part of EDAP's role in supporting EDI in the exercise was through advice and guidance provided to panel members on taking account of EDI in their assessments:

a. At the start of the criteria-setting phase, panels were provided with a detailed equality briefing document which set out the relevant legislative framework and provided guidance on specific equality issues for panels to consider when developing their assessment criteria and working methods. This was followed by two further updated briefing documents ahead of the assessment phase.

b. As a further measure to support the embedding of EDI in REF 2021, all panel members and assessors were required to take an e-learning course on 'Fairness in REF assessment'. The module aimed to introduce panels to the concept of unconscious bias and help individuals to identify their own biases in the context of the assessment process.

c. Following the completion of this training, it was agreed that each main and sub-panel would develop an 'Intention plan', setting out the panel's commitment to mitigating biases and ensuring equitable assessment of REF submissions. The plans typically covered how the panel would ensure awareness of bias was maintained, steps to ensure objectivity, and agreement on the most appropriate way to

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[4] Further details on the individual and unit circumstances process can be found at https://ref.ac.uk/publications-and-reports/guidance-on-submissions-201901/ paras 151-201
[5] https://www.ref.ac.uk/publications-and-reports/guidance-on-submissions-201901/ paras 116-144 and diagram p36

challenge potential biases such as, for example, through randomising reading order. The intention plans were well received by the panels and stressed the importance of working with openness, transparency and challenge. They were refreshed throughout the process of assessment and referred to explicitly in all meetings. Further discussion of the bias mitigation measures, and other measures to promote EDI, are set out in EDAP's end of exercise report[6]. Reflections on the usefulness of the intention plans can be found in the panel overview reports[7].

18. Outputs were allocated for assessment to panel members with appropriate expertise, taking account of any conflicts of interest[8]. Panellists did receive details of to whom the output had been attributed in the submission by the institution, but had no access to data on the protected, or other, characteristics of submitted staff[9]. Outputs were individually scored by panels, using a five-star scale (from 4* to 'unclassified'). All main and sub-panels undertook early calibration exercises to ensure sub-panel members and assessors developed a common understanding of the quality levels. Sub-panels then continued to monitor trends and patterns in scoring to ensure consistency in the sub-panel's standards of assessment. The outputs sub-profile for each submitted unit was then formed by calculating the percentage of outputs listed in a submission that are assigned at each quality level, with each output contributing an equal proportion to the sub-profile.

Data and analysis

19. The following methodologies were used for each of the three analyses within this report[10]:

    a) The rate of submission (staff with significant responsibility for research) by characteristic, against the eligible population
    b) The average number of outputs attributed to submitted staff by characteristic
    c) The average scores of outputs by characteristic.

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[6] Read the full report from EDAP here: https://www.ref.ac.uk/publications-and-reports/equality-and-diversity-advisory-panel-final-report/
[7] Read all four main panel reports here: https://www.ref.ac.uk/publications-and-reports/main-panel-overview-reports/
[8] For more detailed information on approaches taken to allocations, see the panel overview reports: https://www.ref.ac.uk/publications-and-reports/main-panel-overview-reports/
[9] Panel members were able to access staff submissions which included whether or not the individual was classed as an Early Career Researcher for the purposes of REF 2021. See Annex A for relevant descriptions.
[10] Further details of the methodologies used can be found at Annex C)

20. The analysis draws on records of submission to REF 2021, REF assessment data (generated and held between May 2021 and May 2022[11]) and HESA staff data 2019-20.

21. The characteristics covered in this report are listed below.

- Age
- Disability
- ECR status[12]
- Ethnicity
- Gender identity[13]
- Parental leave (within the previous year)
- Religion
- Sex[14]
- Sexual orientation

22. Of the above, the data were not robust enough to provide reliable outcomes for two of the protected characteristics (religion and sexual orientation) due to low return rates to HESA, therefore statistical determination of significance could not be undertaken for submission, outputs attribution and for output scoring for these characteristics. While tests for significance of effect could not be undertaken for these characteristics, data for both rate of submission and for output attribution are reported.

23. Following the 2014 exercise, HEFCE published the 'Selection of staff for inclusion in the REF 2014' (HEFCE 2015/17). That report investigated how disability, age, sex, ethnicity and nationality were related to the selection of staff for inclusion in REF 2014. Due to the changes described above, however, the findings of that report are not comparable with the analysis presented here.

24. This report's analysis of output attribution to submitted staff and analysis of output scoring in REF 2021, are the first such analyses of this type. It is therefore not possible to look at any trends or changes between REF 2014 and REF 2021. They may, however, provide a useful benchmark for examining trends and change in any future exercise. It should be noted that the greater representation of some groups amongst those granted exemption from the minimum-of-one output submission requirement, due to equalities-related circumstances, may consequently affect these elements of the analysis for those groups.

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[11] Data deleted in May 2022 in line with agreed data retention arrangements
[12] These data were taken from the 2019-20 HESA staff return (ECRSTAT), in accordance with the REF 2021 definition for ECRs – see Annex A for further detail on the REF definition of ECR.
[13] This analysis for gender identity is against the HESA G*ender reassignment* field This field records the gender identity of the member of staff, on the basis of their own self-assessment. The field identifies whether the current gender identity is that assigned at birth.
[14] We acknowledge ongoing debates across the equality, higher education and research landscapes on appropriate use of terms, phrases and acronyms, in particular ways of describing sex and gender. For clarity purposes, this report follows the approach set out in the Equality and Diversity Advisory Panel's final report on equality processes and practices in REF 2021 and reflects the usage of terms in HESA (as the primary data source), where the terms 'female' and 'male' are used.

Submitted population

25. Analysis of the submitted population was undertaken to examine the submission rate by protected or other personal characteristics at whole exercise and main panel level. The analysis considers the profile of characteristics of those submitted to the REF against the wider eligible population within HEIs.

Data

26. The **eligible** (Category A eligible) population data is drawn from the 2019-20 HESA staff dataset completed by HEIs, adjusted by the data corrections process undertaken post REF submission, to allow HEIs to correct any errors identified between the HESA dataset and REF submissions data[15]. This provides a baseline (headcount) population of those meeting the eligibility criteria. Data on characteristics of staff were taken from the HESA 2019-20 staff return.

27. The criteria for determining the population of eligible staff included: an Open-ended/Permanent or Fixed-Term contract; contracted as Research Only or Teaching & Research, who had an active contract on census date (31July 2020); and were contracted at a minimum 0.2 FTE on the census date.

28. The **submitted** staff population (Category A submitted) is drawn from the data for staff meeting submission criteria, including significant responsibility for research, submitted to REF 2021. These were matched to the corrected HESA 2019-20 staff record using their HESA staff ID to identify characteristics of interest. The submitted population includes submitted staff granted exemption from the minimum-of-one output submission requirement with no attributed outputs.

29. All staff from units granted a small unit exception[16], due to unit size, were removed from the eligible population, through identification via the approved exception table of the REF submission database. These details including UKPRN, staff ID and UOA were matched against HESA data for the eligible population and the removed. With the above exclusions, the eligible staff population was 105,667.

30. For the submitted population, a total of 81,167 were submitted to REF. Submitted staff with no HESA ID (728) or a HESA ID that that could not be matched to the HESA data (57) were excluded from the analysis. 80,382 staff were able to be matched to HESA data to identify characteristics of interest for use in the analyses, representing circa 76% of the total eligible population.

Methodology

31. To assess the effect of the characteristics on the likelihood of submission, and whether this is statistically significant, a logistic regression with the variables of

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[15] https://ref.ac.uk/guidance-and-criteria-on-submissions/guidance/guidance-on-further-contingency-measures/ Corrections period for errors identified after 31 March
[16] HEIs were able, exceptionally, to request approval from the REF Director for exemption from submission of very small units meeting relevant conditions (staff with significant responsibility <5 FTE, within scope of one UOA, academically distinct, research environment separate and distinct from other units) – for further detail please see https://www.ref.ac.uk/publications-and-reports/guidance-on-submissions-201901/ paras 68-72.

interest was applied. The analysis was against the condition of being submitted as outcome variable, with the characteristics of interest as explanatory variables. The comparison was undertaken with 95% confidence intervals, with adjustment for multiple comparisons.

32. This was used to determine probability of submission and an odds ratio for submission for each characteristic compared to a base characteristic in order to test the statistical significance of variation. The analysis was carried out at main panel level and aggregated to assess the overall behaviour across the exercise, whilst keeping the variability between main panels.

Assumptions and limitations

a) It was not possible to obtain the characteristics of interest for about 1% of the submitted staff, this group was therefore assessed as if they had been non-submitted staff. This is expected to have only a minor effect to the results, but some bias is present in the analysis for this reason.

b) Statistical significance does not necessarily represent a meaningful difference. Statistical significance as calculated depends on the standard error, which is affected by the sample size, and in this analysis some characteristics had large sample sizes, which therefore produced narrow confidence intervals.

Number of attributed outputs

33. Analysis of attributed outputs, across the range of output types submitted, was undertaken to examine the number of outputs attributed to staff by protected or other personal characteristics at whole exercise and main panel level.

Data

34. The headcount of the submitted population was produced from the REF 2021 submission and matched against the HESA staff dataset 2019-2020 to identify characteristics of interest.

35. Data on output attribution was taken from 174,555 outputs[17] weighted to reflect multiple attribution and double weighting. The outputs of former staff were excluded from the analysis and 251 staff were submitted with zero outputs. Outputs were matched to attributed author(s) using the HESA staff identifier to identify equalities or other characteristics. 116 outputs could not be matched in this way, with a total of 174,439 outputs matched.

Methodology

36. To analyse the relationship between the characteristics and the number of outputs attributed a proportional odds linear regression was applied. The analysis was against the number of outputs being submitted as outcome variable, with the

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[17] A total of 185,594 outputs were submitted (including double-weighting acceptances). Outputs for which REF ID numbers could not be matched to HESA data were excluded.

characteristics of interest as explanatory variables. The comparison was undertaken with 95% confidence intervals, with adjustment for multiple comparisons.

37. This was used to calculate a predicted average number of outputs for each characteristic and an odds ratio for the likelihood of a specific characteristic being attributed to a higher number of outputs compared a base characteristic. The analysis was carried out at main panel level and aggregated to assess the overall behaviour whilst keeping the variability between main panels.

Assumptions and limitations
a) The interpretation of the odds ratio assumes that the proportional odds assumption holds, which means that the odds ratios are constant across all levels of the outcome variable.
b) Statistical significance does not necessarily represent a meaningful difference. Statistical significance as calculated depends on the standard error, which is affected by the sample size, and in this analysis some characteristics had large sample sizes, which therefore produced narrow confidence intervals.

Outputs scores by characteristic of attributed author

38. Analysis of output scores was undertaken to examine variation in scoring for outputs attributed to staff by protected or other personal characteristics at whole exercise and main panel level. Subject to data quality, reporting is also against scoring at UOA level.

Data
39. Data on output scores were taken from 175,648 outputs submitted (counting double-weighted outputs as one item). Any co-authored output with more than one attributed author in a given submission were considered as separate instances of the output.

40. The analysis was undertaken on final output scores, as recorded by the assessment panel for each item. Scores were assigned to outputs directly, and not to the attributed authors themselves.

41. 4,240 output submissions were excluded from the data set as it was not possible to ascertain data on equality characteristics for the attributed author; principally due to the HESA staff identifier returned in the REF 2021 submission being missing or not matched with the HESA 2019-20 data set. The outputs attributed to former staff were also excluded from this analysis. As a result, the analysis included the scores for 171,408 outputs.

42. Analysis is presented at whole exercise and main panel level for all characteristics included. Sub-panel level data is included where the analysis is considered reliable. Where the data included groups with fewer than 30 observations at sub-panel level,

the analysis is not considered reliable, and data are therefore not shown for that sub-panel. Where this is the case for a high proportion of sub-panels for a characteristic, only the whole exercise and main panel level data are included.

Methodology

43. To assess the effect of the characteristics on the score, a linear regression with all the variables of interest was fitted for each of the 34 Units of Assessment (UOAs)[18]. Each of the 34 regression models had the same structure. The coefficients of the regression and their standard error was used to estimate confidence intervals for the effect of each characteristic in each UOA.

44. To aggregate the results at both main panel and exercise level, scores were simulated for each UOA based on their mean and standard error, with appropriate weights for each UOA based on the number of outputs. Those simulations were then aggregated to create the distribution for the panels and the total[19].

45. Based on the simulations, central 95% confidence intervals were produced by main panel and total. Therefore, whilst intervals by UOA provide the expected value for their mean, the aggregate (at main panel or exercise level) intervals include differences between UOAs.

Assumptions and limitations

46. The following assumptions and limitations should be considered:

   a) Outputs attributed to the same author were assumed to be independent, for example, where one member of staff was returned with four attributed outputs, the individual was counted four times within the analysis. The effect of the individual staff member was therefore not modelled.
   b) These analyses consider the characteristics of the attributed author of each output, as identified by the submitting institution, even where the output was multi-authored.
   c) Significance refers to observations where the 95% confidence interval[20] did not include zero; that would mean no impact compared to the base effect. Note that the magnitude of the effects vary substantially by characteristic.
   d) The significance of the effects by UOA is highly determined by the sample size and the specific incidence of the characteristic under analysis. For example, for gender identity incidence is very small which provides a large level of uncertainty on the average effects.
   e) The calculation of uncertainty for the main panel and exercise levels assumes that the estimates by UOA can indeed be compared.

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[18] See Annex B for further details

[19] Note that the simulations assumed continuous scores even if in reality the scores were discrete and bound between zero and four.

[20] A confidence interval gives an indication of the degree of uncertainty of an estimate, showing the precision of a sample estimate. The 95% confidence intervals are calculated so that if we repeated the study many times, 95% of the time, the true unknown value would lie between the lower and upper confidence (https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/bulletins/coronavirusandhighereducationstudents/25februaryto7march2022)

Results

Overview

47. The following section presents the overview of outcomes of the three sets of analysis, this also provides an overview of the outputs of the analysis and interpretation of the graphic outputs of the analysis.

48. Greater detail is presented for each of the characteristics of interest in the sections following. Summary data tables are provided for submissions and output attribution, and the graphic outcomes of the data analysis across each of submissions, output attribution and scoring are provided other than where data quality prevented analysis from providing reliable outcomes.

49. For the analysis of inclusion in submissions, each characteristic data tables set out the headcounts for both the eligible and the submitted populations for each subgrouping within the overarching group of interest (e.g. For Sex, subgroupings = Male/Female/Unknown) with the relative proportion of each subgrouping within each population expressed as a percentage of the whole population. The final column in each table sets out the Rate of submission, which is calculated as a percentage of the proportion of each characteristic sub-grouping in the eligible population within the submitted population.

50. For the analysis of outputs attribution for each characteristic, data tables provide the attributed headcount and the average number of outputs attributed to each subgrouping within the overarching group of interest. Averages of attribution are provided at two levels: staff level against the total submitted headcount and adjusted for FTE.

51. All data below whole exercise level are presented subject to the HESA rounding and suppression approach. This approach entails that:

    a) Counts of people are rounded to the nearest multiple of 5.
    b) Percentages (like % of students who are disabled) are not published if they are fractions of a small group of people (fewer than 22.5).
    c) This includes percentage change calculations ([New-Old]/Old) where either the old or new number is less than 22.5.
    d) Averages (like average age or average salary) are not published if they are averages of a small group of people (7 or fewer).

Whole exercise

Submitted population

52. The total eligible population in the analysis is 105,667. Of these, 81,167 were submitted to REF 2021, and of this submitted population 80,382 were able to be

matched to the HESA 2019-20 dataset. This represents a submission rate of circa 76% of those eligible.

53. Figure 1 below summarises the exercise level analysis of all characteristics. For each characteristic considered within this report, the chart demonstrates the variability of effect at exercise level (confidence interval indicated by the black bars with the odds ratio represented by the black dot). The X axis is presented in a logarithmic scale to fairly show the size of the intervals on both sides of 1.

54. The chart shows for each characteristic the odds ratio of making a submission for a specific characteristic compared to a base characteristic, (e.g. disability, compared to no declared disability), and therefore how more or less likely it is for that characteristic to be included for submission compared to the base characteristic. For age, the analysis represents the effect of an individual's current age compared to their current age plus 10 years and the chart presents the average effect across all ages.

55. An odds ratio of 1 indicates that both the characteristic and the base were equally likely to be in a submission, and where the odds ratio confidence interval does not include 1 (i.e., does not extend to include 1 line) this indicates that the finding is statistically significant. For example, in the chart below Black ethnicity staff are on average between 1/2 and 1/3 as likely to be included in a submission as a White member of staff, with the 95% confidence interval at highest above 1/2 but below 1 indicating that the difference is statistically significant from these outcomes being equal.

56. For female staff on average the likelihood of submission skews negatively with the average between 1/2 less likely to be submitted than their male counterpart and 1. Analysis was undertaken to consider any potential relationship between sex being female and full or part-time working, with those working less than full time with a lower likelihood of submission than those working full time. For both, however, the breadth of the confidence range includes 1 (which would be an equal likelihood of submission). This means that it is plausible that the observed effect is caused by chance.

Figure 1- Impact of characteristics on likelihood of submission at exercise level
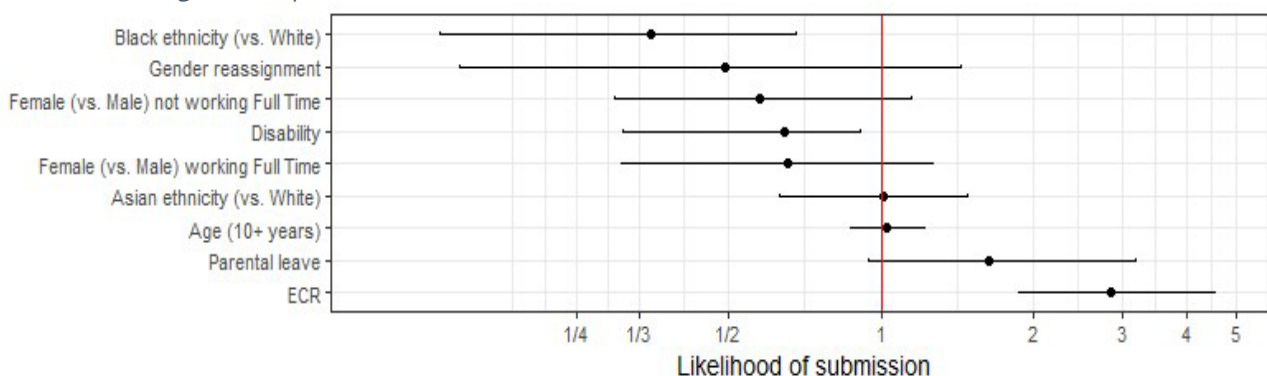

57. Figure 1 indicates that there are statistically significant differences in the likelihood of submission for three groups; showing a negative effect for Black ethnicity at a

close to 1/3 likelihood of submission as compared to White ethnicity, and for disability with an average between 1 and 1/2 likelihood of submission as compared to no declared disability. There was a significant positive effect demonstrated for the likelihood of submission as an Early career researcher (ECR) as compared to non-ECR staff.

Number of attributed outputs

58. 174,439 outputs were matched against 80,371 submitted staff in order to assess the probability of the number of outputs attributed on average to each submitted staff member at whole exercise level and for each characteristic of interest. For all groups at each level the average number will be in the range 1 to 2.5 outputs reflecting the submission requirement of 2.5 outputs per FTE.

59. While the probability of attribution and odds ratio for each characteristic are calculated based on staff headcount (i.e. the total number of staff submitted), attribution against headcount and FTE of staff is also presented in data tables for reference. At the whole exercise level the mean number of outputs attributed against staff headcount is 2.18, while calculated against submitted FTE the mean attribution is 2.32.

60. Figure 2 below summarises the exercise level attribution against submitted headcount for all characteristics. For each characteristic considered within this report, the chart shows the variability of effect at exercise level with a 95% confidence. The confidence interval is indicated by the black bars with the calculated odds ratio represented by the black dot. The X axis is presented in a logarithmic scale.

61. The chart shows for each characteristic the odds ratio for attribution of a higher number of outputs compared to a base characteristic. Analysis was undertaken to consider any potential relationship between sex being female and full or part-time working.

62. An odds ratio of 1 represents both the characteristic and the base were equally likely to be in a submission, where the odds ratio confidence interval does not include 1 this indicates that the finding is statistically significant.

*Figure 2: Impact of characteristics on output attribution at exercise level*
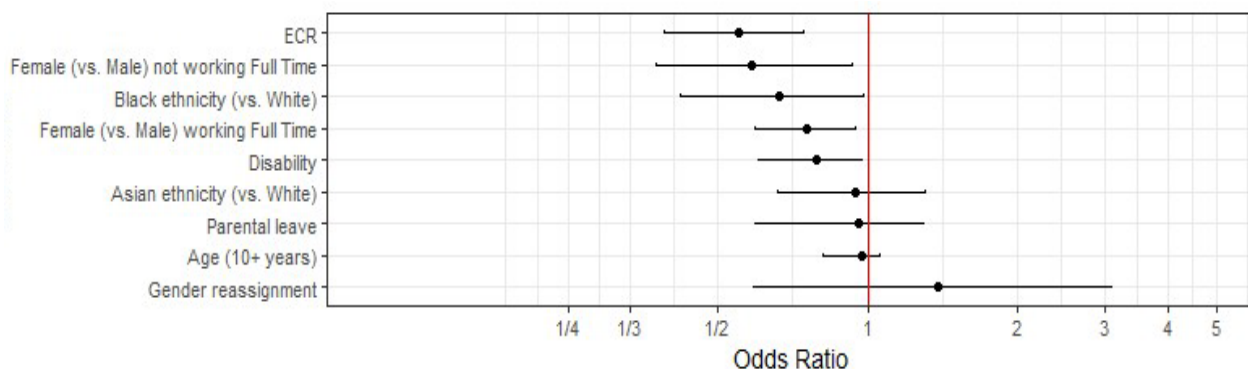
63. ECR staff were least likely to achieve a higher attribution of outputs as compared with non-ECR staff, with a nearly 1/2 odds ratio, and this finding can be seen to be significant. Significant negative results in terms of attribution of outputs were also identified for female staff and disabled staff.

Outputs scores by attributed author

64. For each characteristic considered within this report, the chart demonstrates the variability of effect at exercise level. The charts show the difference between scores on the 0-4 scale for the reference group and the group of interest (denoted by the x axis). 0 therefore represents no difference in score between the reference group and group of interest, whereas -1 means a difference of -1 on the 0-4 scale.

65. The uncertainty for the totals (black lines) use the central 95% confidence interval from data simulated using the 34 sub-panel expected scores, with the centre of the mass (black dot) best represented by the median value across these.

66. As shown in Figure 3, at exercise level across all characteristics examined the median score effect is negative (to differing extents), indicating lower observed scores for the group of interest in comparison to the reference group. None of the differences observed at this level were determined to be statistically significant at the 95% level.

Figure 3: Effects by characteristics on scoring, whole exercise level
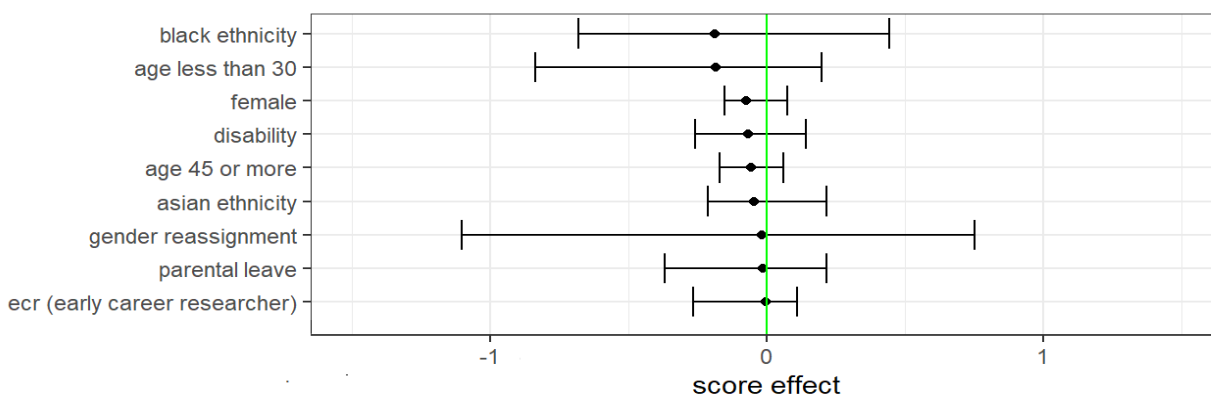
67. In the results sections for each of the characteristics of interest, the charts also provide analysis at main panel level (the 95% confidence interval simulated using the central confidence interval for the relevant set of sub-panel expected scores), and at UOA level where reliable data are available.

Results by characteristic

Age

Submitted population by age

68. Table 1 shows that all age groups within the submitted population were represented roughly in proportion to their representation within the eligible population at exercise level, with the 35-44 group slightly above at 34.3% of the submitted pool compared to 32.1% of the eligible pool. The rates of submission were highest within the 35-44 age group at 81.4% of the eligible population for this age group; submission rates for the remaining age groups were 1.7 to 3.6 percentage points below the average rate of 76.1%,

Table 1: Eligible and submitted populations by Age

AGE	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
18-24	40	0.0%	-		
25-34	10,640	10.1%	7,860	9.8%	73.8%
35-44	33,880	32.1%	27,595	34.3%	81.4%
45-54	32,715	31.0%	24,350	30.3%	74.4%
55+	28,385	26.9%	20,575	25.6%	72.5%
Unknown	5		-		

69. This pattern continues at main panel level, as set out in Table 2 below, with the highest submission rates observed for the 35-44 age group across all main panels. The 45-54 age group had the second highest rate in Main Panels B and D; for Main Panel C, this was the 25-34 group, and the 55+ group for Main Panel A. There is some variation between the main panels in regard to the relative rates of submission for the 25-34 and the 55+ age groups, with 25-34 ranging from 63.1% for Main Panel A to 86.2% in Main Panel B, with 55+ ranging from 64.4% in Main Panel C to 84.6% in Main Panel B.

Table 2: Eligible and submitted populations by age and main panel

Main Panel	Age	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
A	18-24	15		-		
	25-34	2,325	8.0%	1,470	6.9%	63.1%
	35-44	8,960	30.9%	7,010	32.9%	78.3%
	45-54	9,450	32.6%	6,810	31.9%	72.0%
	55+	8,260	28.5%	6,040	28.3%	73.1%
	Unknown	-		-		
B	18-24	5		-		
	25-34	2,460	11.3%	2,125	11.1%	86.2%
	35-44	7,510	34.6%	6,860	35.9%	91.4%
	45-54	6,105	28.1%	5,370	28.1%	87.9%
	55+	5,620	25.9%	4,755	24.9%	84.6%
	Unknown	-		-		
C	18-24	20		-		
	25-34	3,925	11.4%	2,885	11.7%	73.5%
	35-44	11,110	32.3%	8,800	35.7%	79.2%
	45-54	10,430	30.3%	7,235	29.4%	69.4%
	55+	8,885	25.9%	5,720	23.2%	64.4%
	Unknown	-		-		
D	18-24	5		-		
	25-34	1,925	9.4%	1,380	9.0%	71.7%
	35-44	6,300	30.6%	4,920	32.2%	78.1%
	45-54	6,730	32.7%	4,940	32.3%	73.4%
	55+	5,620	27.3%	4,060	26.5%	72.3%
	Unknown	-		-		

70. Analysis of the impact of age on submission is illustrated in Figure 4 below, analysing the impact of current age against an additional 10 years in age. In addition to the black bar showing significance at whole exercise level, significance at main panel level is represented by blue bars,

71. There was no statistically significant impact identified at exercise level. Three of the main panels show a statistically significant effect; for Main Panel C this is a negative effect, while a positive effect is observed for Main Panels A and D. There is no significant effect for Main Panel B.

Figure 4: Impact of age (+10 years) on submission
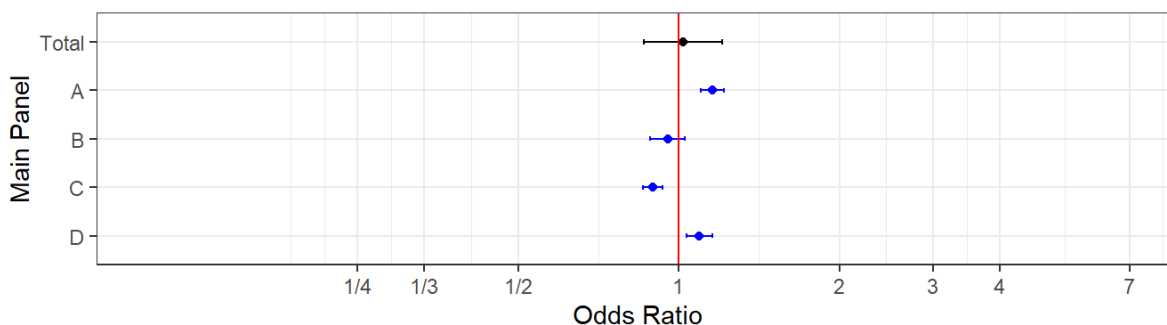
Number of attributed outputs by age

72. Excluding 18-24 and Unknown groups, the attribution levels rise across all age groups with age, with 25-34 the lowest at 1.98 and 55+ the highest at 2.52, compared to the exercise average of 2.32, adjusted for FTE. This is shown in Table 3 below.

Table 3: Attribution of outputs by age

Age	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
25-34	7810	1.93	1.98
35-44	27525	2.19	2.28
45-54	24300	2.21	2.33
55+	20520	2.21	2.52
Unknown	40	1.68	1.79

73. As illustrated in Table 4 this pattern is repeated across all main panels, with the level of attribution rising with each age grouping where adjusted for FTE, except for Main Panel B for which the 35-44 group has the highest attribution.

Table 4: Attribution of outputs by age and main panel

Main Panel	Age	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
A	25-34	1465	1.95	2.02
	35-44	7005	2.13	2.24
	45-54	6805	2.24	2.36
	55+	6020	2.28	2.58
	Unknown	30	1.60	1.68
B	25-34	2120	2.14	2.17
	35-44	6855	2.36	2.42
	45-54	5370	2.27	2.34
	55+	4750	2.13	2.38
	Unknown	0		
C	25-34	2845	1.80	1.83
	35-44	8760	2.15	2.21
	45-54	7210	2.20	2.29
	55+	5700	2.20	2.53
	Unknown	5		
D	25-34	1375	1.85	1.95
	35-44	4905	2.13	2.27
	45-54	4915	2.14	2.31
	55+	4050	2.19	2.58
	Unknown	5		

74. Figure 5 includes analysis at main panel level, represented by blue bars, in addition to the black bars representing significance at whole exercise.

75. For output attribution Figure 5 shows there is no statistically significant effect at exercise level for current age compared to an additional 10 years in age. There is a small statistically significant negative effect for Main Panel B, however there is no significant effect observed for the other three main panels.

Figure 5: Impact of age (+10 years) on outputs attribution
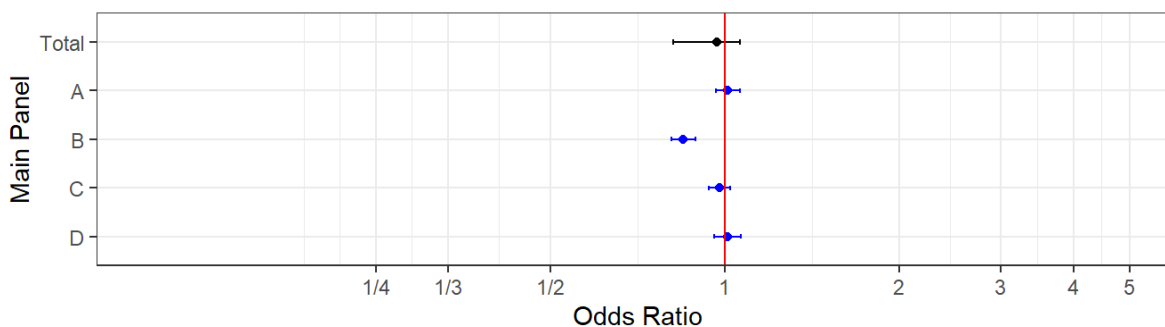
Output scores by age of attributed author

76. Figure 6 shows the score effect of being 45 years old or older on 31 July 2020. The chart shows, in addition to whole exercise level (black bar), analyses at main panel (blue bars) and UOA (red bars) level. At all three levels of reporting thicker bars have been used to indicate where there is a statistically significant effect.

77. There was no statistically significant effect of age at exercise level on output score where the attributed author was over 45 (median effect -0.06). Analysis at main panel and UOA level highlights a more mixed picture, both in terms of the positive or negative direction of differences observed, and whether these differences are statistically significant. No significant effect is observed across three of the four main panels, however a statistically significant negative effect is observed in Main Panel B.

78. At UOA level, a statistically significant negative effect is identified in 18 UOAs as illustrated in Figure 6. For two UOAs a positive effect of age being over 45 is identified which was statistically significant.

Figure 6: Impact of age 45 or more on scoring for main and sub-panels
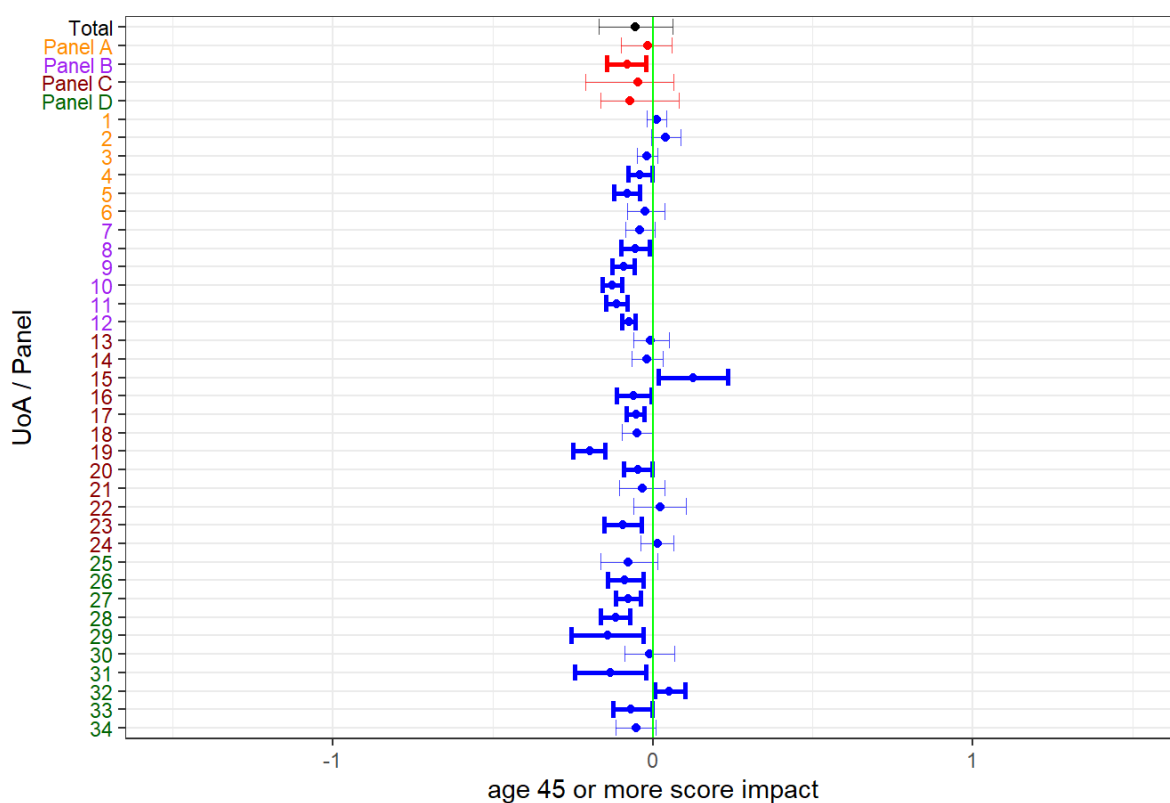
79. There is no statistically significant effect of being under 30 at either exercise level or across all four main panels (See Figure 7 below). The data were not sufficient to produce a reliable analysis in the majority of UOAs.

Figure 7: Impact of age 30 or less on scoring across main panels
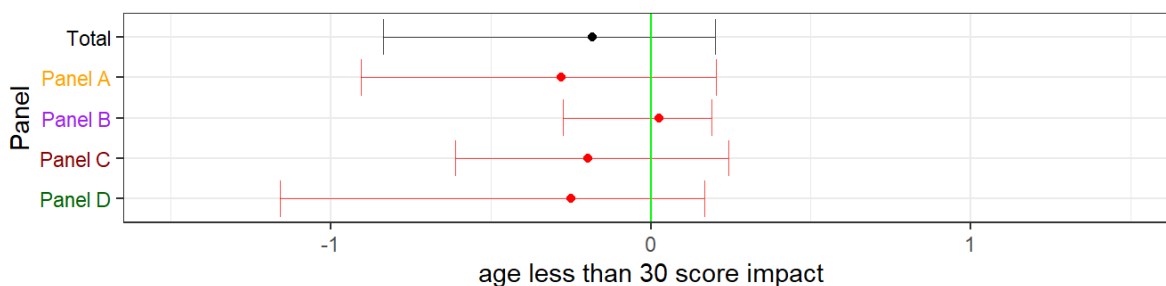
Disability

Submitted population by disability

80. As indicated in Table 5, below, the proportion of the overall submitted population identifying as disabled, non-disabled and unknown mirrors the overall proportions of these groups within in the eligible population. However, when looking at submission rate, a lower rate is observed for staff identifying as disabled (64.4%) compared to the rate for both staff identifying as non-disabled (76.6%) and the Unknown group (77.9%) – showing a 12 to 13 percentage point difference.

Table 5: Eligible and submitted population by disability

Disability	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
No	98,115	93%	75,115	93%	77%
Yes	4,580	4%	2,950	4%	64%
Unknown	2,970	3%	2,315	3%	78%

81. This trend is repeated across all main panel groups (see Table 6), with Main Panel A having the lowest submission rate for staff identifying as disabled (56.8%), and Main Panel B showing the highest rate (75.5%). However, in the context of the main panel average rates of submission, Main Panel D showed the smallest difference (seven percentage points) between the submission rate for disabled staff (67.5%) and the main panel average (74.4%).

Table 6: Eligible and submitted population by disability by main panel

Main Panel	Disability	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
A	No	26,925	93%	19,965	94%	74%
	Yes	1,295	4%	735	3%	57%
	Unknown	790	3%	630	3%	80%
B	No	20,480	94%	18,090	95%	88%
	Yes	590	3%	445	2%	75%
	Unknown	625	3%	570	3%	91%
C	No	31,935	93%	23,000	93%	72%
	Yes	1,530	4%	985	4%	64%
	Unknown	900	3%	655	3%	73%
D	No	18,770	91%	14,060	92%	75%
	Yes	1,165	6%	785	5%	68%
	Unknown	650	3%	460	3%	71%

82. Figure 8 below indicates that there is a statistically significant negative effect on submission for disabled staff, as compared to those not declaring a disability at both exercise level and across all main panels, with the greatest effect observed within Main Panel B.

Figure 8: Impact of disability on likelihood of submission
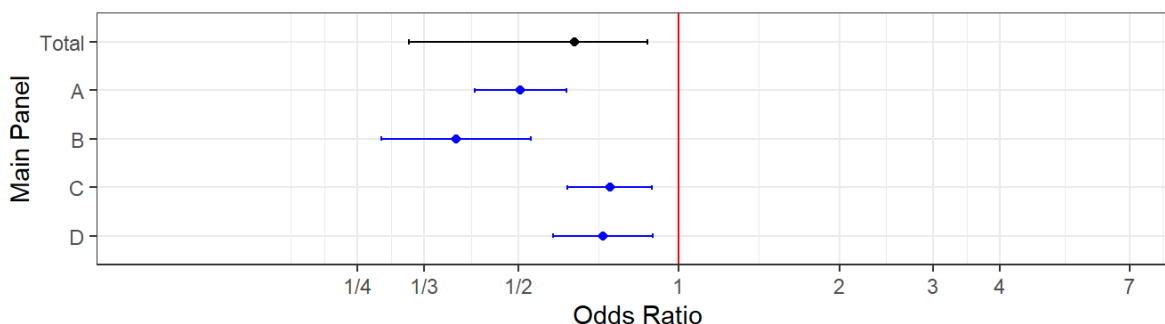
Number of attributed outputs by disability

83. Overall there is a lower level of attribution for those identifying as disabled compared to those identifying as non-disabled or in the unknown population, in both cases with approximately 0.2 outputs fewer attributed This is set out in table 7 below.

Table 7: Attribution of outputs by disability

Disability	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
No	74915	2.18	2.33
Yes	2935	1.96	2.11
Unknown	2340	2.20	2.36

84. The trend of lower attribution is continued across the main panels, with all of the main panels showing lower levels of attribution for those identifying disabled as compared to non-disabled both for individual level and where adjusted for FTE, showing an attribution gap in the range 0.3 (Main Panel A) to circa 0.15 in Main Panel D. This is detailed in Table 8.

Table 8: Attribution of outputs by disability and main panel

Main Panel	Disability	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
A	No	19935	2.20	2.36
	Yes	735	1.96	2.10
	Unknown	655	2.19	2.37
B	No	18085	2.26	2.37
	Yes	445	2.01	2.13
	Unknown	570	2.26	2.38
C	No	22890	2.14	2.26
	Yes	975	1.94	2.07
	Unknown	655	2.19	2.34
D	No	14005	2.13	2.34
	Yes	780	1.97	2.18
	Unknown	465	2.13	2.35

85. Figure 9 below indicates that there is a statistically significant impact on output attribution at exercise level and across all four main panels.

Figure 9: Impact of disability on output attribution
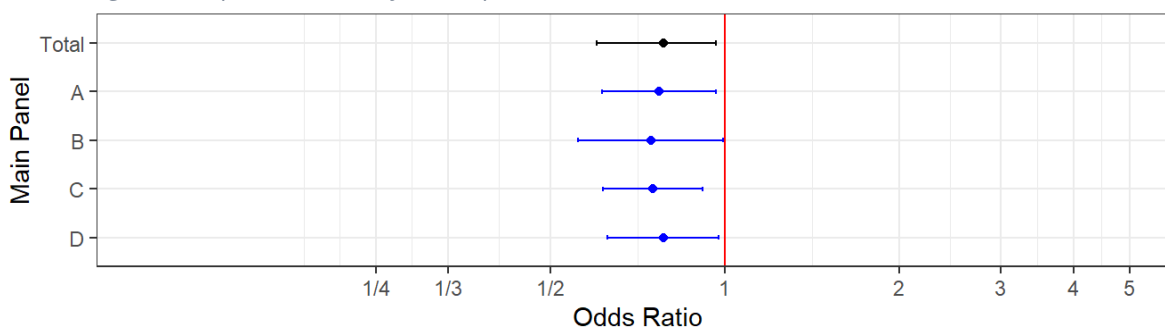
Output scores by disability status of attributed author

86. Analysis shows no statistically significant effect at exercise level of having a declared disability on output score (median effect -0.07). This trend is observed across the four main panels, with no statistically significant difference. This means that it is plausible that the observed effect is caused by chance. See Figure 10, below.

87. At UOA level a negative effect is observed in seven UOAs. Data for two UOAs were not sufficient to produce a reliable analysis.

Figure 10: Impact on scoring of disability at exercise, main panel and UOA level
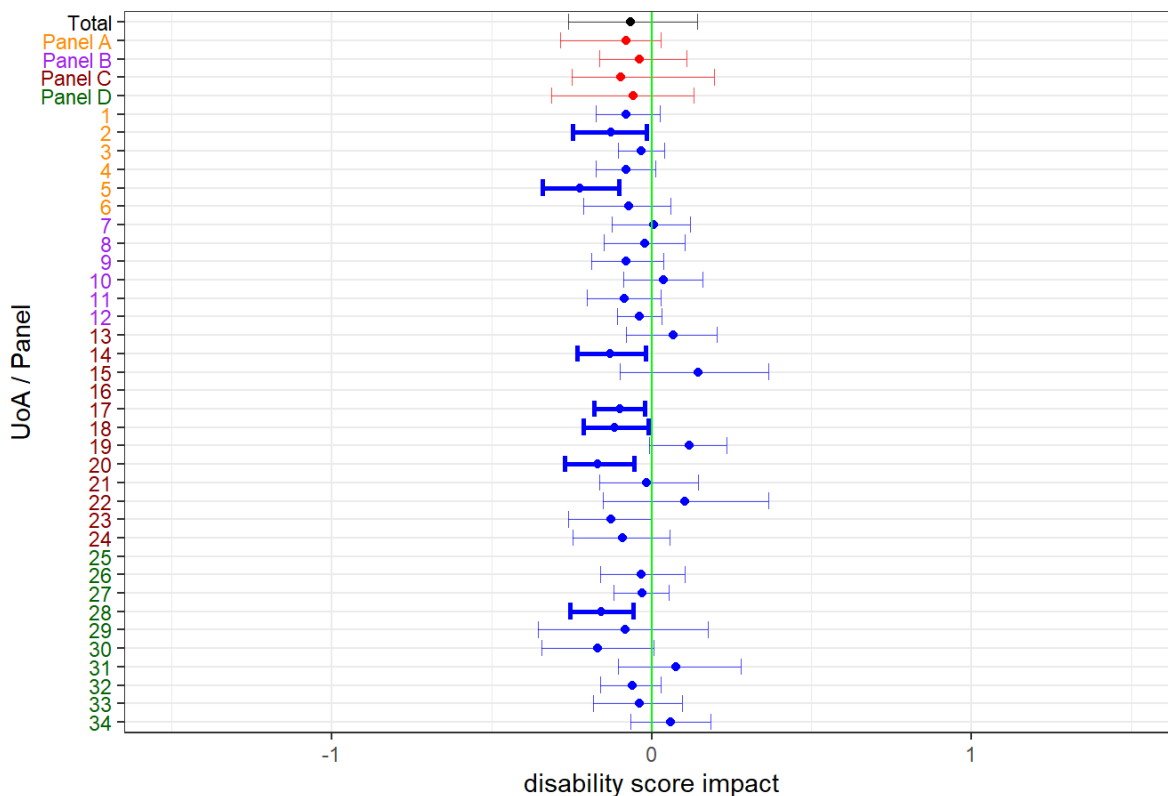
ECR status
Submitted population by ECR status

88. Table 9 sets out details of the eligible and submitted populations by ECR status at exercise level. The unknown category is excluded from further analysis due to low numbers. The data show that ECRs have a higher submission rate than non-ECRs, indicating that ECRs were more likely to be identified as having significant responsibility for research.

Table 9: Eligible and submitted populations by ECR status

ECR	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
No	91,700	86.8%	68,135	84.8%	74.3%
Yes	13,965	13.2%	12,245	15.2%	87.7%
Unknown	-		-		

89. There is some variation observed in the differences between the ECR and non-ECR groups at main panel level, as shown in Table 10, although the proportions of ECRs and non-ECRs in both the eligible and submitted populations are broadly similar across the main panels. In all cases, ECRs showed higher submission rates than non-ECRs.

Table 10: Eligible and submitted populations by ECR status and main panel

Main Panel	ECR	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
A	No	25,000	86.2%	17,885	83.9%	71.6%
	Yes	4,010	13.8%	3,440	16.1%	85.8%
	Unknown	-		-		
B	No	18,510	85.3%	16,050	84.0%	86.7%
	Yes	3,190	14.7%	3,055	16.0%	95.7%
	Unknown	-		-		
C	No	29,910	87.0%	20,840	84.6%	69.7%
	Yes	4,460	13.0%	3,800	15.4%	85.3%
	Unknown	-		-		
D	No	18,280	88.8%	13,360	87.3%	73.1%
	Yes	2,305	11.2%	1,945	12.7%	84.5%
	Unknown	-		-		

90. This is further illustrated in Figure 11 below, which shows that at whole exercise level and across all main panels there is a statistically significant positive effect on likelihood of submission for ECR staff. This is most notable in Main Panel B.

Figure 11: Impact of ECR status on submission
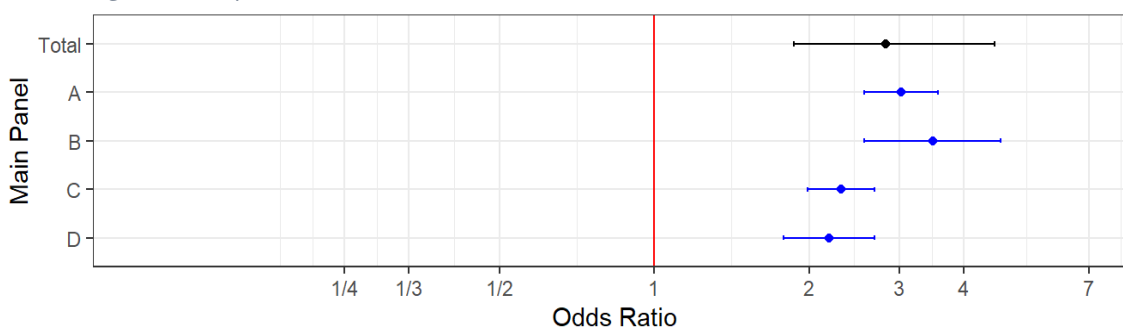
Number of attributed outputs by ECR status

91. Table 11 below illustrates a lower level of output attribution on average by ECR status, both by staff headcount and FTE. This manifests as a 0.4 (headcount) to 0.5 (FTE) variation against non-ECR submissions.

Table 11: Attribution of outputs by ECR status

ECR Status	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
No	68005	2.24	2.40
Yes	12125	1.83	1.90
Unknown	60	1.68	1.84

92. Table 12 below sets out the variation in output attribution by main panel. Across all main panels there is a lower rate of output attribution for ECRs, with the greatest differences between ECRs and non-ECRs observed in Main Panel C (0.57 by headcount) and the least within Main Panel B (0.22 by headcount).

Table 12: Output attribution by ECR status by main panel

Main Panel	ECR status	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
A	No	17860	2.25	2.42
	Yes	3425	1.91	1.99
	Unknown	40	1.74	1.84
B	No	16045	2.29	2.41
	Yes	3045	2.07	2.10
	Unknown	5		
C	No	20775	2.22	2.36
	Yes	3740	1.65	1.70
	Unknown	5		
D	No	13325	2.19	2.40
	Yes	1915	1.67	1.82
	Unknown	10	1.36	1.58

93. Figure 12 shows a significant negative statistical effect on outputs attribution for ECRs as compared to non-ECR staff. This is most pronounced for Main Panels C and D

Figure 12: Impact of ECR status on output attribution
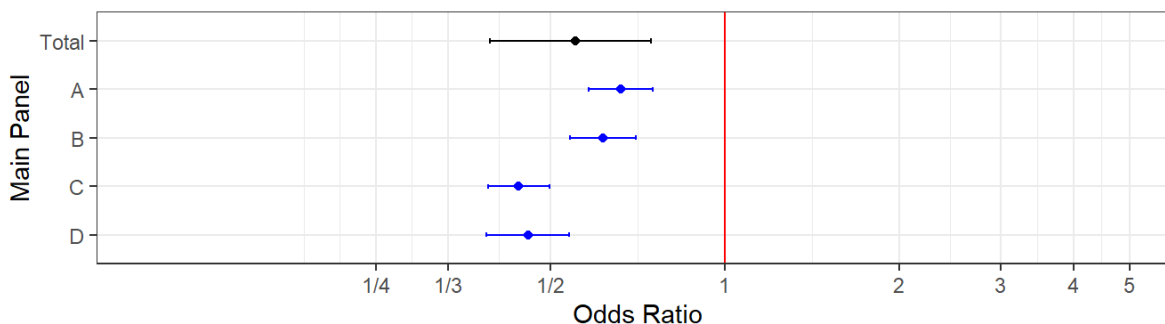
Output scores by ECR status of attributed author

94. As shown in Figure 13: impact on the score of ECR status, by overall, main panel and UOA, at exercise level, analysis highlights a neutral effect on output score (median effect 0.00) of having an attributed author with ECR status.

95. This is also reflected at main level with no statistically significant difference observed at this level, although trends do diverge. A positive effect is observed for Main Panels A and B, and a negative effect observed for Main Panels C and D, although none of these effects are statistically significant. This means that it is plausible that the observed effect is caused by chance.

96. There are nine UOAs, all within Main Panels C and D for which there is a statistically significant difference in output scoring. A significant positive effect of ECR status on output score was observed for five UOAs within Main Panels A and B.

Figure 13: impact on the score of ECR status, at exercise, main panel and UOA levels
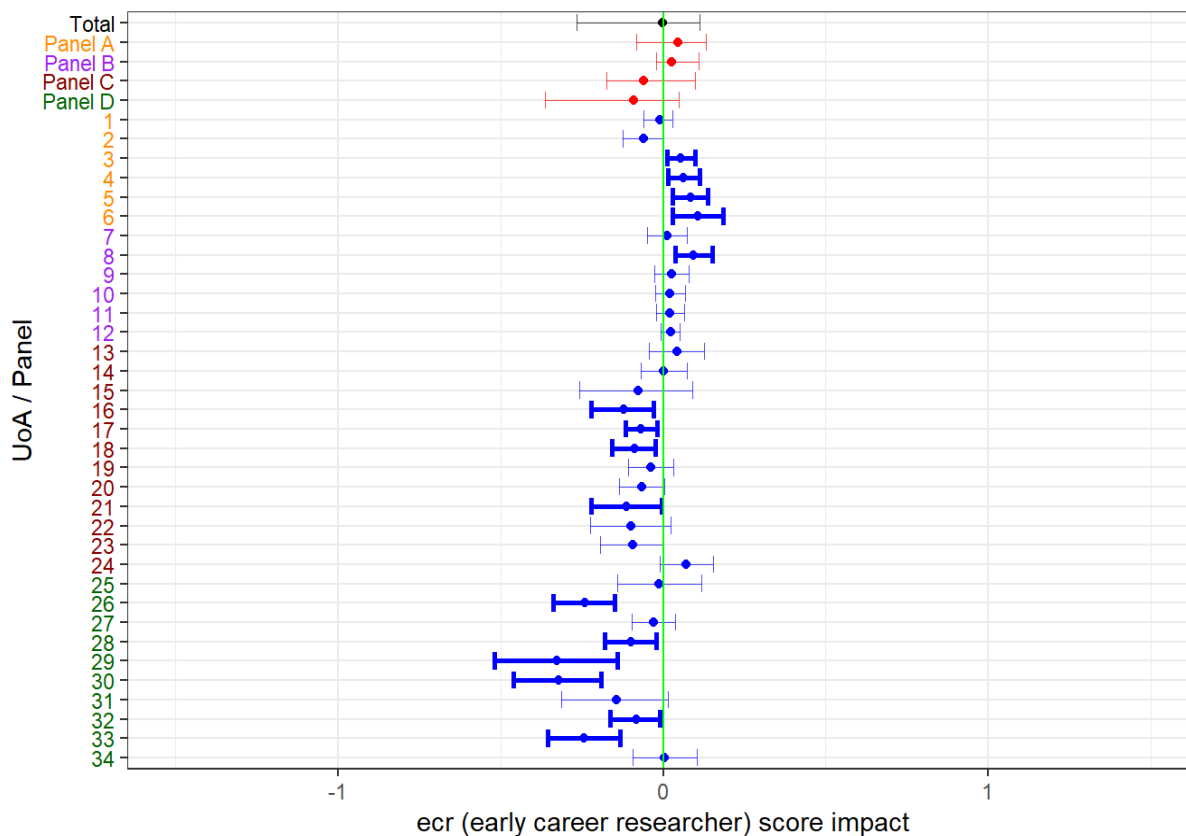
Ethnicity

Submitted population by ethnicity

97. At the exercise level, the proportions of staff from different ethnicities observed in the submitted population broadly mirror that of the eligible population across most groupings (see Table 13). However, as the rate of submission highlights, there are notable differences within this. The greatest difference from the overall submission rate of 76.1% is observed for Black staff, where the rate is 53.4%, a difference of 22.7 percentage points.

Table 13: Eligible and submitted populations by ethnicity

Ethnicity	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
White	82,890	78.4%	62,385	77.6%	75.3%
Black	2,010	1.9%	1,075	1.3%	53.4%
Asian	9,520	9.0%	7,645	9.5%	80.3%
Mixed	2,180	2.1%	1,675	2.1%	76.7%
Arab	450	0.4%	330	0.4%	73.3%
Other	1,705	1.6%	1,405	1.7%	82.4%
Unknown	6,910	6.5%	5,875	7.3%	85.0%

98. Table 14 sets out more detail on the data for Black staff, highlighting further variation in submission rates. A notably lower rate is observed for staff from Black

or Black British Caribbean backgrounds at 37.2%. This indicates that Black or Black British Caribbean staff meeting the definition of 'Category A eligible' for REF 2021 were less likely to be identified as having significant responsibility for research than staff from other ethnic backgrounds that also met this definition. Staff from other Black backgrounds show the highest submission rate (70.4%).

99. The data on the prevalence of staff by ethnic group by institutional TRAC group (see Annex D), may provide some insight into the lower rates observed for Black staff as staff from each ethnic group are not evenly distributed across institution types. The data on ethnicity show higher proportions of staff from Black backgrounds in the eligible pool particularly in institutions from Peer Groups C, D and E (3-4%) compared with groups A and B (1%). Institutions in Peer Groups C to F were much more likely to run processes to determine significant responsibility for research, meaning the submission rate observed is between 42 and 53%, than institutions in Peer Groups A and B where the rate is between 98 and 100%.

100. Given the above, we might expect to see a proportionally lower rate of submission for staff from groups that have a higher representation at some types of institution. However, the data on submission rate within each TRAC group also highlights proportionally lower submission rates for Black staff. For example, Peer Group D has the highest proportion of staff from Black backgrounds in the eligible pool (4%), but has one of the lowest observed submission rates at 30.9% for Black staff, compared with 41.6% for Peer Group D overall.

Table 14: Eligible and submitted populations by Black background

Black background	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
Black or Black British - Caribbean	405	20.0%	150	14.0%	37.2%
Black or Black British - African	1450	72.1%	815	75.6%	56.1%
Other Black background	160	7.9%	110	10.4%	70.4%

101. This trend is continued across all main panels, with Black groups submitted at a significantly lower level as shown in Table 15 and Figure 14 below The lowest submission rates are observed in Main Panel A at 46.5%, with the highest observed in Main Panel B at 62.6% – however, this is still 25 percentage points below the Main Panel B average submission rate of 88%. Across the main panels, the rate for Black staff is 16 to 27 percentage points lower than the average submission rate for that main panel. The smallest gap at 16 percentage points is observed in Main Panel D, where the average rate is 74%.

Table 15: Eligible and submitted populations by ethnicity and main panel

Main Panel	Ethnicity	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
A	White	23,660	81.6%	17,105	80.2%	72.3%
	Black	480	1.7%	225	1.0%	46.5%
	Asian	2,075	7.1%	1,645	7.7%	79.3%
	Mixed	530	1.8%	415	2.0%	78.5%
	Arab	90	0.3%	65	0.3%	69.6%
	Other	330	1.1%	270	1.3%	81.8%
	Unknown	1,845	6.4%	1,605	7.5%	87.1%
B	White	15,595	71.9%	13,785	72.1%	88.4%
	Black	280	1.3%	175	0.9%	62.6%
	Asian	3,290	15.2%	2,850	14.9%	86.6%
	Mixed	375	1.7%	330	1.7%	87.5%
	Arab	145	0.7%	115	0.6%	78.6%
	Other	470	2.2%	410	2.2%	87.6%
	Unknown	1,540	7.1%	1,440	7.5%	93.5%
C	White	26,460	77.0%	18,725	76.0%	70.8%
	Black	1,040	3.0%	555	2.2%	53.3%
	Asian	3,385	9.8%	2,565	10.4%	75.7%
	Mixed	745	2.2%	530	2.2%	71.2%
	Arab	165	0.5%	110	0.5%	68.7%
	Other	605	1.8%	475	1.9%	79.1%
	Unknown	1,975	5.7%	1,680	6.8%	85.1%
D	White	17,170	83.4%	12,770	83.4%	74.4%
	Black	210	1.0%	120	0.8%	57.8%
	Asian	775	3.8%	585	3.8%	75.9%
	Mixed	530	2.6%	400	2.6%	75.0%
	Arab	50	0.2%	40	0.3%	79.6%
	Other	300	1.5%	245	1.6%	81.8%
	Unknown	1,550	7.5%	1,145	7.5%	73.9%

102. There are statistically significant differences at whole exercise and main panel level for submission of Black staff members as compared with White staff members. Overall, there is a close to 1/3 likelihood of submission for Black staff, and this is more pronounced for Main Panels A and B with the lowest likelihood of submission being in Main Panel B with a lower than 1/4 likelihood.

Figure 14: Impact of Black ethnicity on likelihood of submission
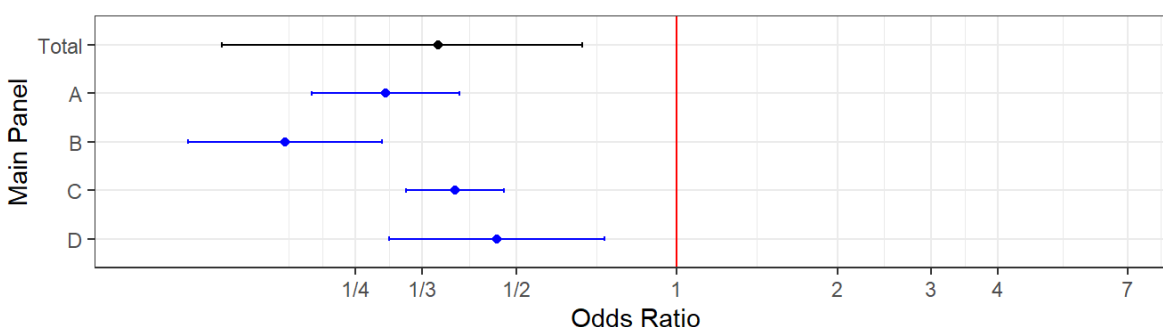
103. For Asian staff there is no significant variation at whole exercise level and for Main Panels C and D as shown in Figure 15 below. However, there are significant effects observed for Main Panels A and B, with A showing a statistically significant positive effect and B a negative.

Figure 15: Impact of Asian ethnicity on likelihood of submission
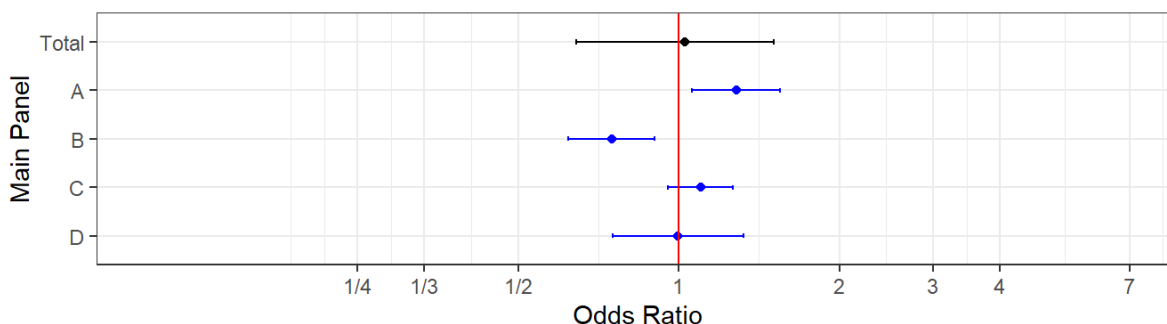
Number of attributed outputs by Ethnicity

104. There is some variation across the average number of outputs attributed to staff by ethnic background, both by headcount and FTE as set out in Table 16 below. In both cases, the lowest averages are observed for staff from a Black background at between 0.3 and 0.4 outputs below the overall averages of 2.18 (headcount) and 2.32 (FTE). Of staff with a declared ethnic group, the highest level of attribution was for staff from White backgrounds, at on or just above the overall averages.

Table 16: Number of attributed outputs by ethnicity

Ethnicity	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
White	62235	2.18	2.34
Black	1070	1.86	1.92
Asian	7610	2.15	2.22
Mixed	1665	2.09	2.20
Arab	325	2.06	2.11
Other	1400	2.10	2.21
Unknown	5885	2.26	2.45

105. This trend continues across main panels as set out in Table 17 below. This shows that Black staff have a lower or joint lowest level of attribution across all main panels at individual staff level and in all but one case (Main Panel A) where it is second lowest to the Arab group when adjusted for FTE. In all cases both at individual staff level and adjusted for FTE, the average attribution for the Black group was below two outputs, this was the case for only one other group in one main panel (Arab, in Main Panel A), with all other groupings showing attribution of greater than 2 outputs.

Table 17: Number of attributed outputs by ethnicity by main panel

Main Panel	Ethnicity	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
A	White	17085	2.19	2.35
	Black	225	1.89	1.96
	Asian	1640	2.14	2.24
	Mixed	415	2.11	2.22
	Arab	65	1.89	1.91
	Other	270	2.11	2.23
	Unknown	1630	2.37	2.60
B	White	13775	2.23	2.35
	Black	175	1.95	1.96
	Asian	2850	2.36	2.41
	Mixed	330	2.27	2.32
	Arab	115	2.11	2.15
	Other	410	2.28	2.37
	Unknown	1440	2.30	2.43
C	White	18645	2.17	2.30
	Black	550	1.85	1.88
	Asian	2535	1.96	2.00
	Mixed	525	1.98	2.06
	Arab	110	2.07	2.10
	Other	475	2.01	2.09
	Unknown	1675	2.22	2.40
D	White	12725	2.14	2.35
	Black	120	1.75	1.97
	Asian	585	2.02	2.13
	Mixed	395	2.07	2.26
	Arab	40	2.15	2.37
	Other	245	1.96	2.13
	Unknown	1140	2.11	2.34

106. As illustrated in Figure 16 below, while overall the level of attribution at whole exercise level for Black staff compared to White, and for two of the Main Panels, B and D are not statistically significant, for Main Panels, A and C there is a statistically significant negative effect observed.

Figure 16: Impact of Black ethnicity on output attribution
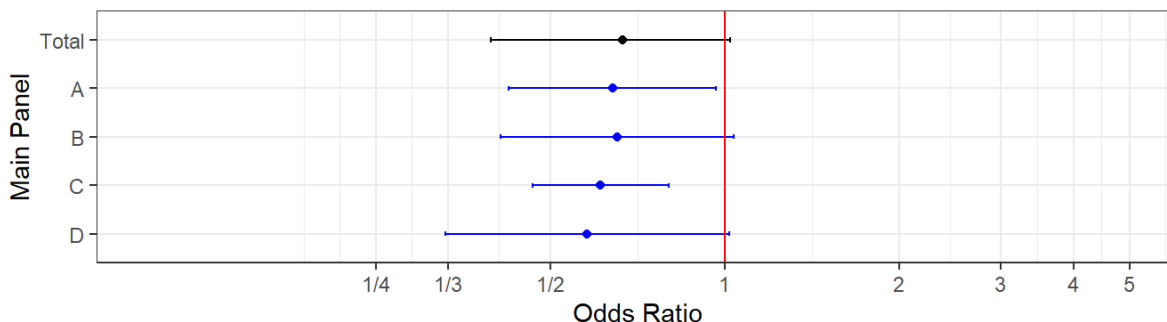
107. For Asian staff, as illustrated in Figure 17, there was no statistical significance in outputs attribution at exercise level and for two of the main panels (A and D). There were significant effects observed for Main Panels B and C with a positive effect noted for B and a negative one observed for C.

Figure 17: Impact of Asian ethnicity on output attribution
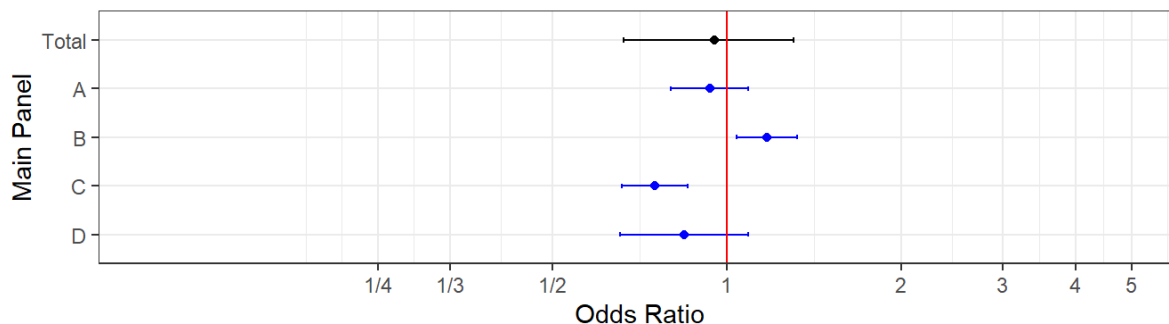
Output scores by ethnicity of attributed author

108. The impact of ethnicity of the attributed author on output score was analysed by using the most prevalent ethnic group (White) as the reference group, against which to assess the second most prevalent ethnicity (Asian) and, in view of notable differences observed for this group across the analyses here, attributed authors from Black backgrounds. Reported ethnicities have been grouped at this high level due to the small sample sizes that occur where these data are broken down to a more granular level.

109. Analysis highlights no statistically significant effect at exercise level where the attributed author is from a Black background, as illustrated in Figure 18. There are also no significant effects observed for any of the main panels. This means that it is plausible that the observed effect is caused by chance. The overall low number of outputs attributed to staff from Black backgrounds is reflected in the wide intervals for this group.

110. Given that a high proportion of UOAs did not have sufficient data to produce reliable analysis, data are presented at exercise and main panel level only for the Black ethnic group.

Figure 18: Impact of Black ethnicity on scores at exercise and main panel level
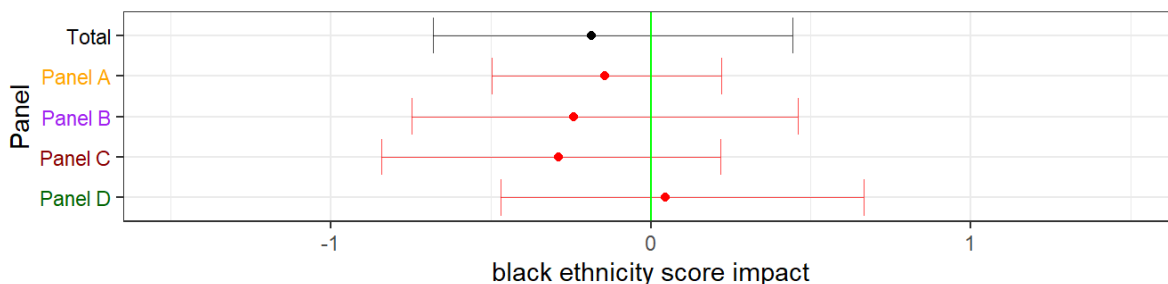
111. No statistically significant effect on output score is observed at exercise level where the attributed author identified as Asian. This also the case across all four main panels. This means that it is plausible that the observed effect is caused by chance.

112. For this ethnic group, the data were sufficient across the majority of UOAs to produce reliable analysis at this level; data are not shown for UOAs where this was not the case. As shown in Figure 19, seven UOAs show a statistically significant negative effect. A positive effect of having an attributed author from an Asian background is observed for four UOAs at a statistically significant level.

Figure 19: Impact of Asian ethnicity on scoring at exercise, main panel and UOA level
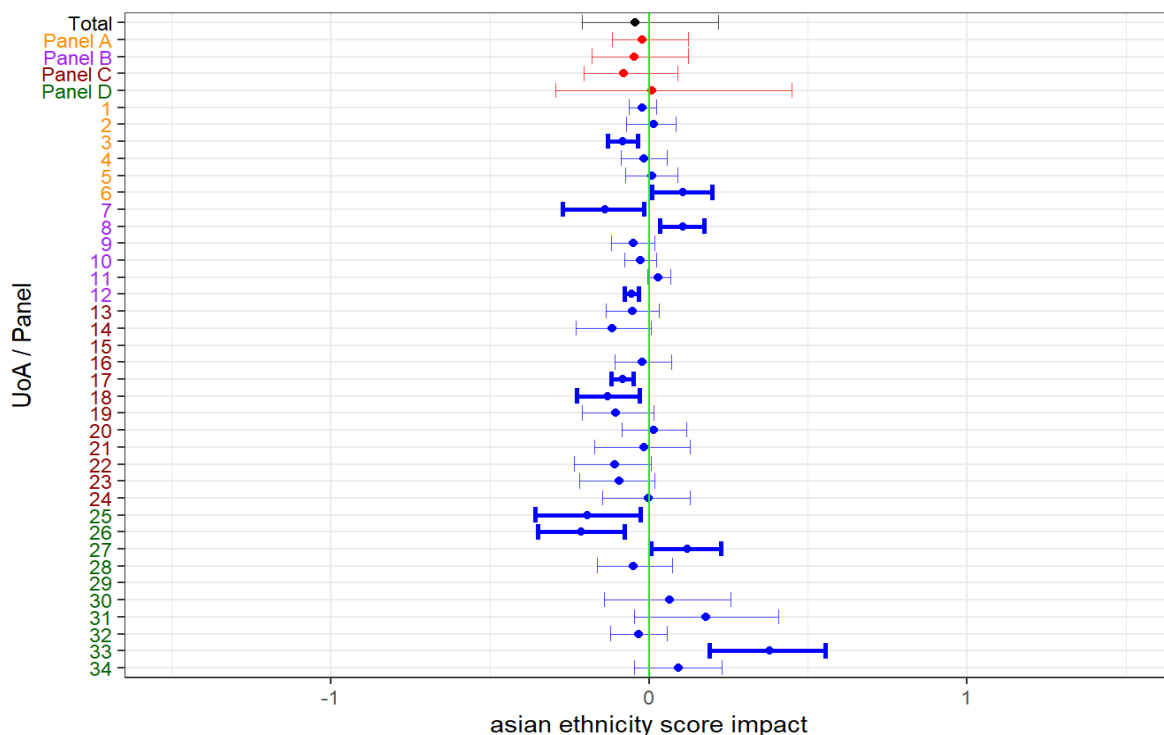
Gender identity

Submitted population by gender identity

113. For those identifying their gender as not being the same as that assigned at birth, there was a lower submission rate observed (47.9%) than for those identifying their gender as the same as at birth (74.7%). There is substantial variation in submission rates observed across the main panels for those identifying their gender as different to that assigned at birth, ranging from 34.7% for Main Panel C to 79.6% in Main Panel B.

Table 18: Eligible and submitted populations by gender identity

Gender assigned at birth	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
Yes	28,765	27.2%	21,490	26.7%	74.7%
No	435	0.4%	210	0.3%	47.9%
Unknown	76,465	72.4%	58,685	73.0%	76.7%

114. It should be noted that across all panels and across the exercise as a whole the number of submitted staff identifying their gender as different to that assigned at birth is low, particularly across Main Panels A, B and D. Additionally, response rates to this question in the HESA staff record are low; the 'Unknown' group make up 72% of the eligible population and 73% of the submitted population.

Table 19: Eligible and submitted populations by gender identity and main panel

Main Panel	Gender assigned at birth	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
A	**Yes**	8,295	28.6%	5,855	27.4%	70.6%
	No	55	0.2%	30	0.1%	52.7%
	Unknown	20,660	71.2%	15,445	72.4%	74.8%
B	**Yes**	6,070	28.0%	5,460	28.6%	90.0%
	No	50	0.2%	40	0.2%	79.6%
	Unknown	15,580	71.8%	13,605	71.2%	87.3%
C	**Yes**	9,255	26.9%	6,380	25.9%	68.9%
	No	245	0.7%	85	0.3%	34.7%
	Unknown	24,870	72.4%	18,175	73.8%	73.1%
D	**Yes**	5,145	25.0%	3,795	24.8%	73.8%
	No	85	0.4%	55	0.4%	64.4%
	Unknown	15,355	74.6%	11,455	74.8%	74.6%

115. Figure 20, below shows that there is no statistically significant negative effect on submission for staff identifying their gender as different to that assigned at birth at exercise level and across three of the main panels, though there is a significant negative effect in Main Panel C.

Figure 20: Impact of gender identity on likelihood of submission
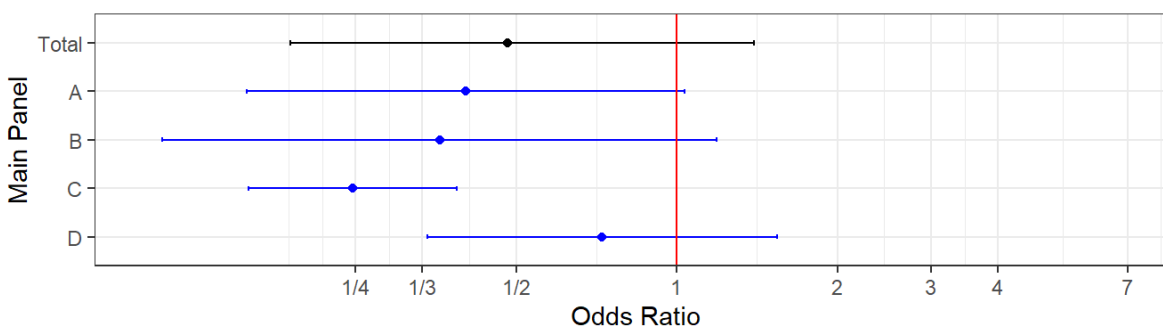
Number of attributed outputs by gender identity

116. Overall, there was minimal difference in levels of attribution of outputs for those not identifying with their gender assigned at birth (0.02 adjusted for FTE).

Table 20:Number of attributed outputs by gender identity

Gender assigned at birth	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
Yes	21430	2.17	2.30
No	210	2.14	2.28
Unknown	58550	2.18	2.33

117. However, there was some variation at main panel level with a 0.52 of an output on average difference within Main Panel A for those not identifying with gender at birth, to near parity in Main Panels B and C, and with Main Panel D showing a slight favourability to this group. As with submission, the Unknown group was seen to have the highest levels of attribution, other than in Main Panel D.

Table 21: Number of attributed outputs by gender identity and main panel

Main Panel	Gender assigned at birth	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
A	Yes	5855	2.18	2.34
	No	30	1.79	1.82
	Unknown	15440	2.20	2.36
B	Yes	5455	2.25	2.34
	No	40	2.59	2.64
	Unknown	13600	2.25	2.37
C	Yes	6330	2.11	2.23
	No	85	2.11	2.21
	Unknown	18105	2.14	2.27
D	Yes	3790	2.11	2.32
	No	55	2.07	2.41
	Unknown	11405	2.13	2.33

118. Figure 21, below shows that there is no statistically significant negative effect on outputs attribution for staff identifying their gender as different to that assigned at birth, both at exercise level and across the main panels.

Figure 21: Impact of gender identity on outputs attribution
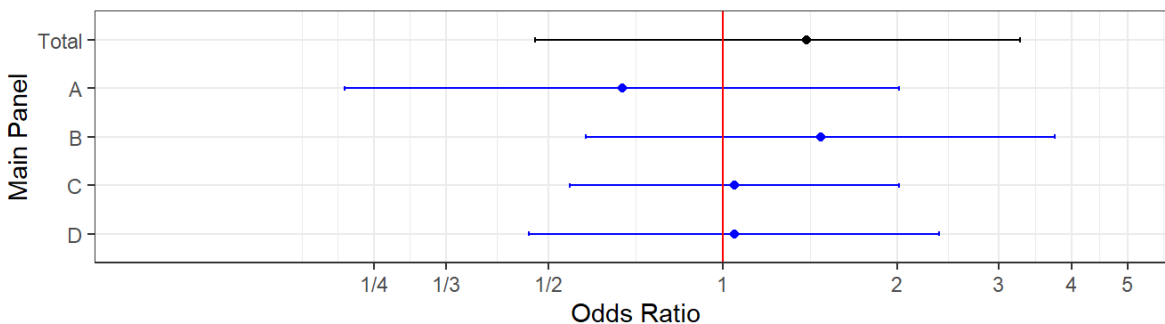
Output scores by gender identity of attributed author

119. Figure 22 shows that there is no statistically significant effect of gender identity on scores of attributed outputs across the exercise or at main panel level, meaning that it is plausible that variation in the observed effects are caused by chance

120. The prevalence of declaring a different gender identity to that assigned at birth was extremely low; for this reason, reliable analyses could not be produced for the majority of UOAs. It also means the main panel and total level intervals are very wide.

Figure 22: Impact of gender identity on scoring at exercise and main panel level
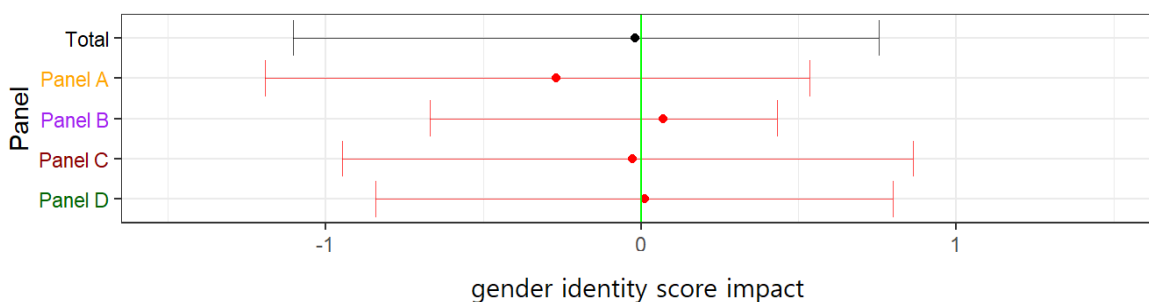
Parental leave (within the previous year)
Submitted population by parental leave

121. The analysis indicates that for those identifying as having taken parental leave within the previous year, the rates of submission were slightly above the average by circa 2 percentage points (78.3% compared with 76.1% for the overall population).

Table 22: Eligible and submitted populations by parental leave

Parental Leave	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
Yes	1,340	1.3%	1,050	1.3%	78.3%
No/Unknown	104,330	98.7%	79,335	98.7%	76.0%

122. In only one main panel (Main Panel A) was the submission rate for those having taken parental leave below (by less than one percentage point) those who had not taken leave, with rates of submission ranging from 72.7% (Main Panel A) to 92.0% (Main Panel B).

Table 23: eligible and submitted populations by parental leave and main panel

Main Panel	Parental Leave	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
A	Yes	390	1.4%	285	1.3%	72.7%
	No/Unknown	28,615	98.6%	21,045	98.7%	73.5%
B	Yes	225	1.0%	210	1.1%	92.0%
	No/Unknown	21,475	99.0%	18,900	98.9%	88.0%
C	Yes	470	1.4%	355	1.4%	75.3%
	No/Unknown	33,900	98.6%	24,290	98.6%	71.6%
D	Yes	250	1.2%	200	1.3%	80.5%
	No/Unknown	20,335	98.8%	15,105	98.7%	74.3%

123. There was no significant impact at exercise level or across three of the main panels of parental leave taken within the previous year, on likelihood of submission. There was a statistically significant positive impact observed for Main Panel A

Figure 23: Impact of parental leave on likelihood of submission
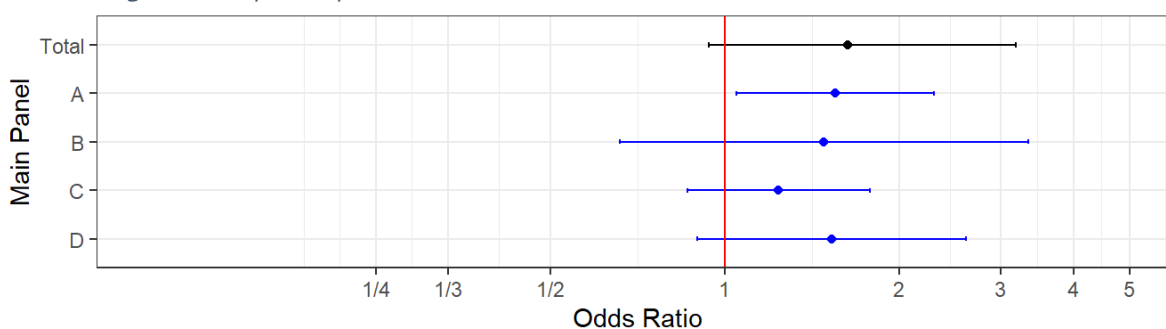
Number of attributed outputs by parental leave

124. There was an output attribution difference between groups identified in the analysis, with those having taken parental leave attributed 0.3 of an output less on average than those who had not. There is potential of some impact on attribution rate for those having taken parental leave within the previous year as a consequence of unit circumstances having been identified and a reduced number of outputs required.

Table 24: Number of outputs attributed by parental leave

Parental Leave	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
Yes	1045	1.95	2.07
No/Unknown	79145	2.18	2.32

125. This pattern was replicated across main panels with this variation ranging from 0.1 in Main Panel D to 0.4 in Main Panel A.

Table 25: Number of outputs attributed by parental leave and main panel

Main Panel	Parental Leave	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
A	Yes	285	1.83	1.97
	No/Unknown	21040	2.20	2.36
B	Yes	210	2.14	2.20
	No/Unknown	18890	2.26	2.36
C	Yes	350	1.91	1.99
	No/Unknown	24170	2.14	2.26
D	Yes	200	2.02	2.22
	No/Unknown	15050	2.12	2.33

126. Figure 24, below shows that there is no statistically significant effect observed for parental leave on output attribution at whole exercise or at main panel level.

Figure 24: Impact of parental leave on outputs attribution
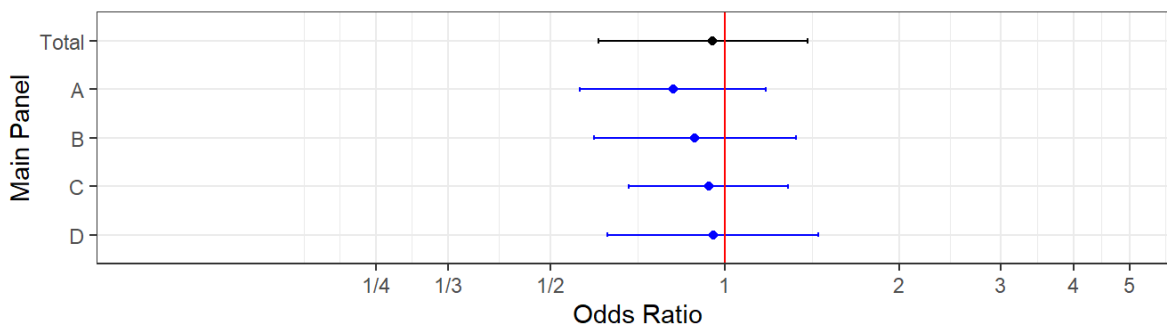
Output scores by parental leave status of attributed author

127. Analysis shows that there is no statistically significant effect at exercise level (median effect -0.01) on the output score of having an attributed author who had taken parental leave in the previous year. This is mirrored at main panel level with no significant effect for any main panel, meaning that it is plausible for differences observed to be caused by chance. The data were not sufficient to produce reliable analysis across a high proportion of UOAs.

128. Intersectional analyses were undertaken to consider any possible impact of sex on these findings, but none of these differences proved to be statistically significant.

Figure 25: Impact of parental leave on scoring at exercise and main pane level
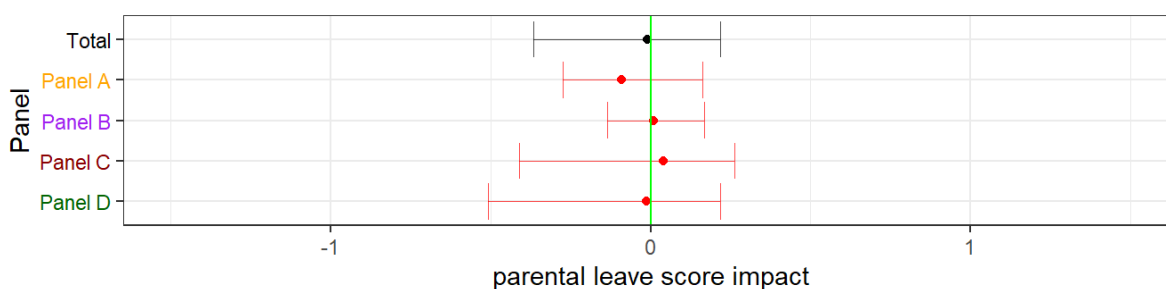
Religion or belief

Submitted population by religion or belief

129. Overall, the submitted population by religion or belief broadly mirrors the eligible population. The response rate to this question in the HESA staff record is quite low, with the 'unknown' group comprising 59.6% of the eligible population (and 61.2% of the submitted). Across responding groups, the most prevalent group in the eligible pool are staff identifying with 'No religion' (21%), followed by the Christian group (14.3%). Representation across remaining groups ranged from 0.1% to 1.8%.

130. The data show some variation in submission rate by religion or belief, as shown in Table 26. The highest submission rate was observed for Jewish staff at 85.1%, with the lowest rate observed for Sikh staff (48.6%).

Table 26: Eligible and submitted populations by religion or belief

Religion or belief	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
No religion	22,140	21.0%	17,350	21.6%	78.4%
Buddhist	500	0.5%	365	0.5%	73.3%
Christian	15,120	14.3%	9,880	12.3%	65.3%
Hindu	770	0.7%	580	0.7%	75.8%
Jewish	560	0.5%	475	0.6%	85.1%
Muslim	1,505	1.4%	1,045	1.3%	69.7%
Sikh	140	0.1%	70	0.1%	48.6%
Other	1,940	1.8%	1,420	1.8%	73.2%
Unknown	63,000	59.6%	49,190	61.2%	78.1%

131. The picture is broadly similar at main panel level with the Jewish group showing the highest submission rates across all main panels in a range from 81.4% to 95.3%, although overall representing a numerically small grouping (1% or below) for each of the main panels.

Table 27: Eligible and submitted populations by religion or belief and main panel

Main Panel	Religion or belief	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
A	No religion	6,110	21.1%	4,705	22.1%	76.9%
	Buddhist	135	0.5%	95	0.4%	69.1%
	Christian	5,050	17.4%	2,980	14.0%	59.0%
	Hindu	265	0.9%	195	0.9%	73.7%
	Jewish	140	0.5%	115	0.5%	81.4%
	Muslim	325	1.1%	235	1.1%	71.7%
	Sikh	45	0.2%	25	0.1%	56.8%
	Other	500	1.7%	340	1.6%	68.5%
	Unknown	16,440	56.7%	12,645	59.3%	76.9%
B	No religion	4,400	20.3%	3,945	20.7%	89.7%
	Buddhist	85	0.4%	70	0.4%	81.9%
	Christian	2,640	12.2%	2,250	11.8%	85.1%
	Hindu	210	1.0%	170	0.9%	79.2%
	Jewish	65	0.3%	60	0.3%	95.3%
	Muslim	510	2.4%	385	2.0%	75.5%
	Sikh	15		10		
	Other	350	1.6%	310	1.6%	88.3%
	Unknown	13,420	61.8%	11,905	62.3%	88.7%
C	No religion	6,685	19.4%	5,060	20.5%	75.7%
	Buddhist	200	0.6%	150	0.6%	73.6%
	Christian	5,355	15.6%	3,190	12.9%	59.5%
	Hindu	255	0.7%	195	0.8%	76.3%
	Jewish	185	0.5%	155	0.6%	84.4%
	Muslim	565	1.6%	365	1.5%	64.2%
	Sikh	60	0.2%	25	0.1%	40.0%
	Other	650	1.9%	460	1.9%	71.1%
	Unknown	20,415	59.4%	15,045	61.1%	73.7%
D	No religion	4,940	24.0%	3,640	23.8%	73.7%
	Buddhist	80	0.4%	55	0.4%	70.4%
	Christian	2,075	10.1%	1,465	9.6%	70.6%
	Hindu	35	0.2%	25	0.2%	67.6%
	Jewish	170	0.8%	145	0.9%	85.1%
	Muslim	100	0.5%	65	0.4%	64.0%
	Sikh	20		5		
	Other	440	2.1%	305	2.0%	69.5%
	Unknown	12,725	61.8%	9,600	62.7%	75.4%

132. Reporting of religion and belief though HESA data was insufficient to allow a robust analysis of its impact on likelihood of submission.

Number of attributed outputs by religion or belief

133. At whole exercise level there is some variation in the level of attribution of outputs against the identified groupings with the Unknown grouping showing the highest level of attribution (2.53 outputs adjusted for FTE) followed by Jewish (2.34) and No religion (2.31). the lowest level of attribution adjusted for FTE was for the Muslim grouping at 2.02 outputs, with Buddhist at 2.12 and Sikh at 2.13.

Table 28: Number of outputs attributed by religion or belief

Religion or belief	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
No religion	17305	2.18	2.31
Buddhist	365	2.01	2.12
Christian	9840	2.11	2.25
Hindu	580	2.12	2.22
Jewish	470	2.13	2.34
Muslim	1045	1.97	2.02
Sikh	70	2.03	2.13
Other	1415	2.12	2.27
Unknown	49100	2.20	2.35

134. In all cases across the main panels the highest levels of attribution are for the Unknown grouping, with variation between the panels for levels of attribution for different groups; the No religion group was among the three highest attributed groups across all main panels, as shown in Table 29, below.

Table 29: Number of outputs attributed by religion or belief and main panel

Main Panel	Religion or belief	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
A	No religion	4700	2.19	2.33
	Buddhist	95	2.01	2.10
	Christian	2980	2.12	2.28
	Hindu	195	2.10	2.26
	Jewish	115	2.09	2.36
	Muslim	235	1.96	2.03
	Sikh	25	1.76	1.80
	Other	340	2.19	2.35
	Unknown	12640	2.22	2.39
B	No religion	3945	2.29	2.37
	Buddhist	70	2.18	2.26
	Christian	2245	2.21	2.33
	Hindu	170	2.31	2.40
	Jewish	60	1.95	2.06
	Muslim	385	2.09	2.14
	Sikh	10	2.42	2.42
	Other	310	2.21	2.29
	Unknown	11905	2.26	2.37
C	No religion	5030	2.15	2.26
	Buddhist	145	1.96	2.02
	Christian	3160	2.04	2.15
	Hindu	190	2.04	2.08
	Jewish	155	2.13	2.35
	Muslim	360	1.89	1.92
	Sikh	25	2.33	2.56
	Other	455	2.09	2.23
	Unknown	14990	2.16	2.29
D	No religion	3625	2.09	2.30
	Buddhist	55	1.96	2.24
	Christian	1455	2.08	2.27
	Hindu	25	1.64	1.76
	Jewish	140	2.23	2.45
	Muslim	65	1.72	1.84
	Sikh	5		
	Other	305	1.98	2.24
	Unknown	9565	2.15	2.35

135. Reporting of religion and belief though HESA data was insufficient to allow a robust analysis of its impact on output attribution.

Output scores by religion and belief of attributed author

136. Reporting of religion and belief though HESA data was insufficient to allow a robust analysis of its impact output scoring.

Sex

Submitted population by sex

137. As shown in Table 30, female staff represent 42.1% of the total eligible population, with male staff comprising 57.7% of the eligible population. However, the ratio of female to male staff within the submitted population was lower at 38% to 61.8%. This represents a lower rate of submission for female staff at 68.7% against the eligible population, compared to 81.4% submission rate for male staff.

138. This indicates female staff meeting the definition of 'Category A eligible' for REF 2021 were less likely to be identified as having significant responsibility for research than male staff meeting this definition.

Table 30: Eligible and submitted populations by sex

SEX	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
Male	61,020	57.7%	49,690	61.8%	81.4%
Female	44,485	42.1%	30,550	38.0%	68.7%
Other	150	0.1%	135	0.2%	89.3%
Unknown	15		10		

139. There is some variation to the overall picture by main panel, with submission rates showing a notable difference between the female and male rates in Main Panels A and C– see Table 31, below. A small difference is also observable in Main Panel B, although the overall submission rates in this main panel area are higher than for the total population (76.1%); while the rates for Main Panel D show no notable difference.

Table 31: Eligible and submitted populations by sex and main panel

Main Panel	Sex	Eligible Headcount	% of Eligible	Submitted Headcount	% of submitted	Rate of submission %
A	Male	14,385	49.6%	12,095	56.7%	84.1%
	Female	14,575	50.2%	9,190	43.1%	63.0%
	Other	40	0.1%	35	0.2%	90.2%
	Unknown	5		5		
B	Male	17,380	80.1%	15,460	80.9%	89.0%
	Female	4,300	19.8%	3,625	19.0%	84.3%
	Other	20		20		100%
	Unknown	5		-		
C	Male	18,390	53.5%	14,030	56.9%	76.3%
	Female	15,930	46.3%	10,565	42.9%	66.3%
	Other	50	0.2%	45	0.2%	82.7%
	Unknown	-		-		
D	Male	10,865	52.8%	8,100	52.9%	74.6%
	Female	9,680	47.0%	7,170	46.8%	74.0%
	Other	35	0.2%	35	0.2%	91.9%
	Unknown	5		5		

140. The chart below (Figure 26) shows the odds ratio for the likelihood of submission for female staff compared to a base characteristic of male. At whole exercise level this finding is not statistically significant. However, there are statistically significant effects observed for three of the four main panels, and where the proportionate likelihood of submission for female staff can be seen to be lower than for male staff. In Main Panel A the odds ratio shows a 1/3 likelihood while for both Main Panel B and Main Panel C the odds ratio is close to 1/2.

Figure 26: Impact of being female on likelihood of submission

44
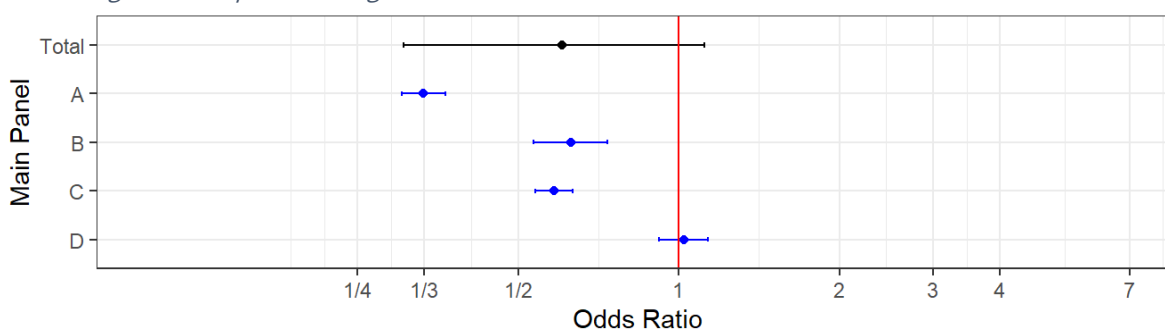
141. Further intersectional analysis was undertaken to consider the potential relationship between female sex and part-time working, and the charts at Figure 27 below compare the odds ratios for female staff working less than full-time with those working full-time, as compared to male staff working full or part-time. For female staff working part-time there is a negative skew compared to full-time staff, both at exercise level and for all main panels other than for Main Panel A, for which part-time working indicates a marginal improvement in likelihood of submission. Results are not statistically significant at exercise level; however the negative effect is statistically significant in three out of four main panels for those working part- and full-time.

Figure 27: Impact of being female and part- or full-time working on likelihood of submission
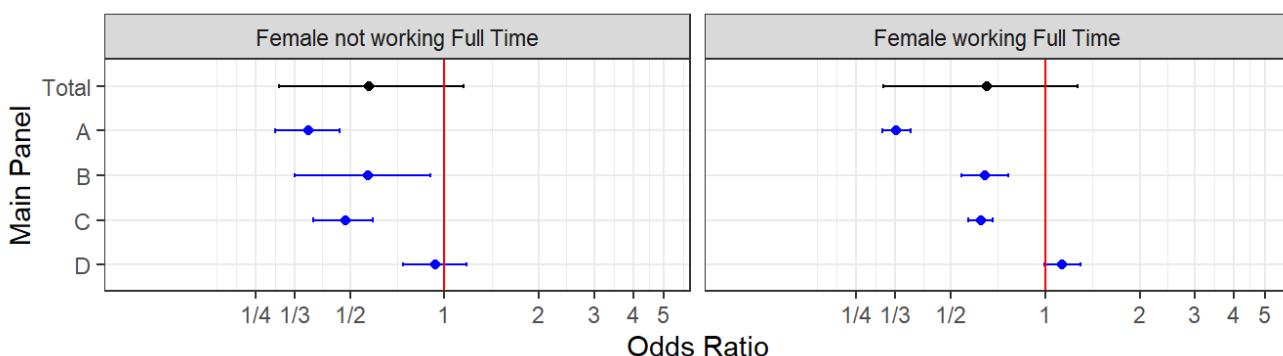
Number of attributed outputs by sex

142. Table 32 shows the average number of outputs attributed per staff headcount and per FTE, by sex. For both measures, lower levels of attribution are observed for female staff than for male staff. This difference may be accounted for in part by maternity-leave related adjustments.

Table 32: Number of outputs attributed by sex

| Sex	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
Male	49580	2.29	2.43
Female	30435	2.00	2.15
Other	135	2.06	2.31
Unknown	40	1.68	1.79

143.Table 33 illustrates the average level of attribution by sex at main panel level. There is again variation in the differences observed between female and male staff by main panel; however, in all cases female staff had lower levels of output attribution than males. The greatest difference is observed in Main Panel A, with a 0.4 difference between the average number of outputs attributed per headcount and FTE. The smallest differences were observed in Main Panel D (0.17 by headcount and 0.15 by FTE).

Table 33: Number of outputs attributed by sex and main panel

Main Panel	Sex	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
A	Male	12085	2.37	2.52
	Female	9170	1.97	2.12
	Other	35	2.19	2.66
	Unknown	30	1.60	1.68
B	Male	15450	2.30	2.41
	Female	3620	2.06	2.16
	Other	20	2.35	2.57
	Unknown	0		
C	Male	13975	2.25	2.38
	Female	10500	1.99	2.10
	Other	45	1.95	2.16
	Unknown	5		
D	Male	8070	2.20	2.40
	Female	7145	2.03	2.25
	Other	35	1.88	2.00
	Unknown	5		

144.In terms of the statistical significance of these variations, Figure 28 below illustrates the variation in likelihood of female staff having a higher level of outputs attributed compared to male staff. At whole exercise level and for all main panels, the odds ratio sits between 1 and 1/2 and all these differences are significant statistically. This is most pronounced for Main Panel A and least for Main Panel D.

Figure 28: Impact of being female on output attribution
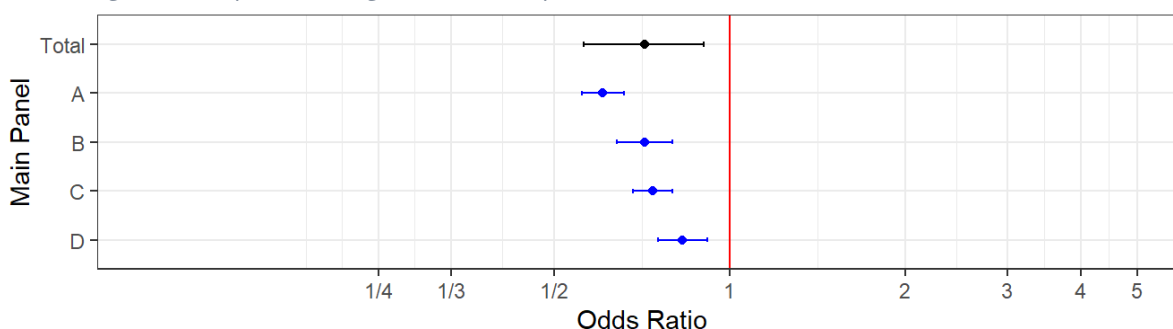
145.Analysis of the impact of working part or full-time on female compared to male staff shows a significant variation for whole exercise and all main panels, skewed

further towards a lower probability of attribution of a higher number of outputs for female staff compared to male colleagues also working part-time. For female staff working full-time this can be seen to slightly reduce the differences in probability however at exercise and main panel levels, there remains a statistically significant negative effect as illustrated in the charts at Figure 29.

Figure 29: Impact of being female and part- or full-time working on outputs attribution
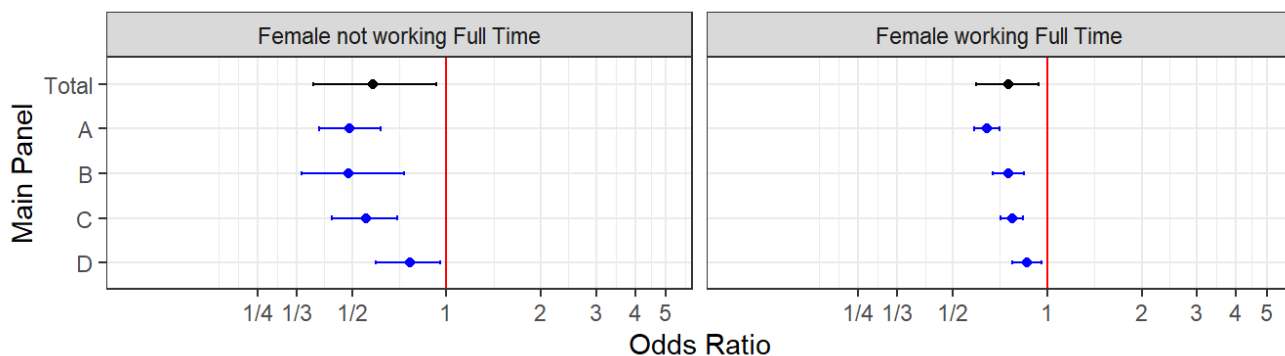
Output scores by sex of attributed author

146. At whole exercise level there was no evidence of an association between sex of the attributed author and the output score, although the median effect size of scores of outputs attributed to female authors was slightly negative (median effect size 0.09).

147. There are statistically significant differences in Main panels A and B, while for Main panels C and D, there is a negative effect observed, however this is non-significant statistically.

148. As illustrated in Figure 3022 of the UOAs show a negative effect which is statistically significant. A positive effect of having a female attributed author is statistically significant in one UOA. The data show a generally consistent negative trend for this characteristic across the UOAs, which contrasts with the analysis for other characteristics detailed in this report, where a more mixed picture is seen.

Figure 30: impact on the score of sex being female at exercise, main panel and UOA level
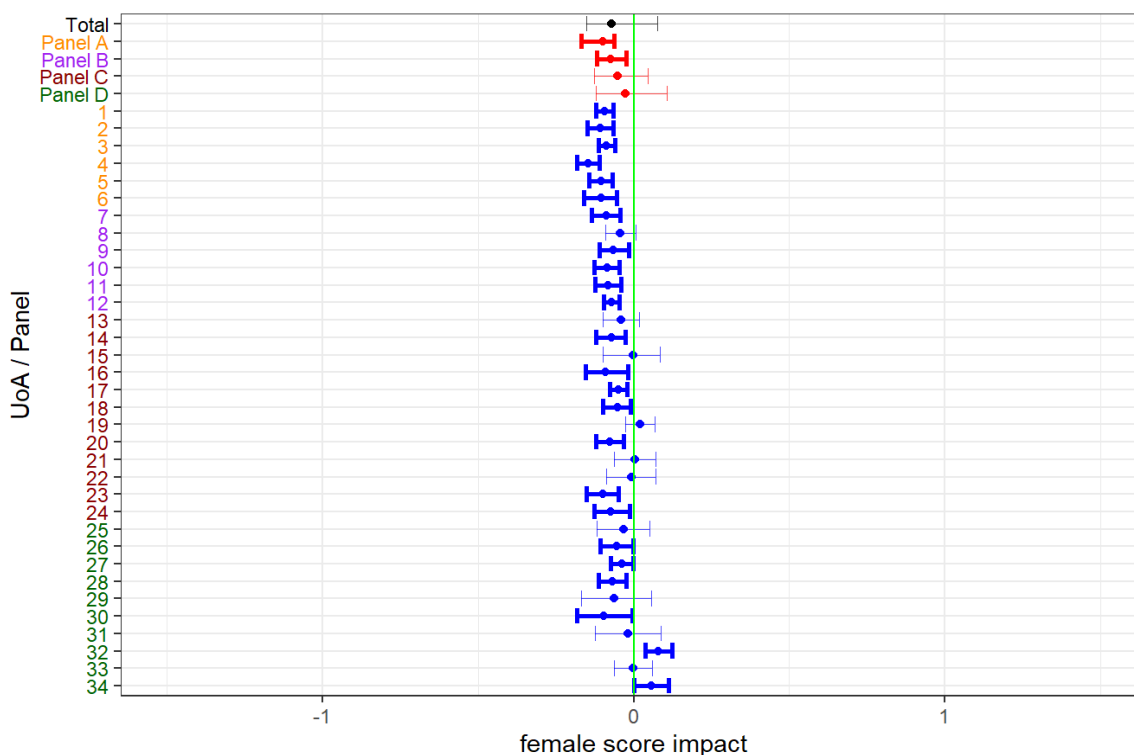
Sexual orientation

Submitted population by sexual orientation

149. Analysis shows that for those identifying as lesbian, gay or bisexual (LGB) there is a slightly higher submission rate (75.0%), than those identifying as heterosexual (71.9%), with the LGB proportion close to the whole exercise average of circa 76.1%. These two groups collectively account for almost 39% of the total submitted population (2.7% LGB and 36.1% Heterosexual) with LGB broadly proportionate to this group within the eligible population. However, the groups with greatest submission rates are those identifying sexual orientation as 'other' (77.7%) and the 'Unknown' group (78.8%). This group has the highest representation in the total submitted population (60.9%).

Table 34: Eligible and submitted populations by sexual orientation

Sexual orientation	Eligible Headcount	% of Eligible	Submitted Headcount	% of Submitted	Rate of submission %
LGB	2,920	2.8%	2,190	2.7%	75.0%
Heterosexual	40,355	38.2%	29,030	36.1%	71.9%
Other	305	0.3%	235	0.3%	77.7%
Unknown	62,085	58.8%	48,925	60.9%	78.8%

150. Across the main panels there is some variation, with LGB submission rates higher than the Heterosexual group in Main panels B, C and D, and marginally lower in Main Panel A. LGB staff across all main panels are represented within the submitted population at about the same level as within the eligible population.

Table 35: eligible and submitted populations by sexual orientation and main panel

Main Panel	Sexual orientation	Eligible Headcount	% of Eligible	Submitted Headcount	% of Submitted	Rate of submission %
A	LGB	685	2.4%	465	2.2%	67.5%
	Heterosexual	11,900	41.0%	8,180	38.4%	68.7%
	Other	55	0.2%	40	0.2%	66.7%
	Unknown	16,365	56.4%	12,645	59.3%	77.3%
B	LGB	290	1.3%	255	1.3%	87.6%
	Heterosexual	8,045	37.1%	6,940	36.3%	86.2%
	Other	40	0.2%	35	0.2%	83.3%
	Unknown	13,320	61.4%	11,875	62.2%	89.2%
C	LGB	920	2.7%	665	2.7%	72.3%
	Heterosexual	13,655	39.7%	9,180	37.3%	67.2%
	Other	85	0.3%	65	0.3%	77.0%
	Unknown	19,710	57.4%	14,730	59.8%	74.7%
D	LGB	1,025	5.0%	805	5.3%	78.7%
	Heterosexual	6,755	32.8%	4,730	30.9%	70.0%
	Other	120	0.6%	95	0.6%	81.5%
	Unknown	12,690	61.6%	9,675	63.2%	76.3%

151. Reporting of sexual orientation through HESA was insufficient to allow a reliable analysis to be undertaken of impact on submission.

Number of attributed outputs by sexual orientation

152. While there is a slight disparity between output attribution between those identifying as LGB and those identifying as Heterosexual (with LGB 0.03 outputs lower, where adjusted for FTE), this translates to a 0.1 output lower attribution against the Unknown grouping.

Table 36: Number of outputs attributed by sexual orientation

Sexual orientation	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
LGB	2180	2.11	2.25
Heterosexual	28940	2.15	2.28
Other	235	2.02	2.14
Unknown	48835	2.19	2.35

153. In Main Panels A and B there is a circa 0.1 variation between LGB and Heterosexual groups with the latter showing higher attribution, and with similar levels of attribution between these groups in Main Panel D and a slightly favourable (0.04) disparity in Main Panel C for LGB staff. In all cases the Unknown group were more highly attributed than other groups.

Table 37: Number of outputs attributed by sexual orientation and main panel

Main Panel	Sexual orientation	Headcount	Average no. attributed outputs per staff member	Average no. attributed outputs per FTE
A	LGB	465	2.08	2.21
	Heterosexual	8180	2.16	2.31
	Other	40	2.05	2.11
	Unknown	12640	2.22	2.39
B	LGB	255	2.16	2.25
	Heterosexual	6930	2.25	2.34
	Other	35	2.31	2.48
	Unknown	11875	2.26	2.37
C	LGB	660	2.19	2.26
	Heterosexual	9120	2.11	2.21
	Other	65	1.87	1.87
	Unknown	14675	2.15	2.28
D	LGB	800	2.03	2.26
	Heterosexual	4710	2.09	2.28
	Other	95	2.00	2.25
	Unknown	9645	2.15	2.36

154. Reporting of sexual orientation through HESA was insufficient to allow a reliable analysis to be undertaken of impact on output attribution.

Output scores by sexual orientation of attributed author

155. Reporting of sexual orientation though HESA data was insufficient to allow a robust analysis of impact on output scoring.

Discussion

156. Following REF 2014, analysis was undertaken on the protected, and other, characteristics of those submitted to the exercise. However, it is important to note that this analysis was of a selective submission regime unlike the one in place for REF 2021 which required submission of all staff meeting the requisite criteria. Consequently, the analysis of submission in the 2021 exercise is not directly comparable with one undertaken in 2014. This is the first time that analyses have been undertaken on REF output attribution and scoring by these characteristics of interest of attributed author(s).

157. These analyses will contribute to the evaluation of REF 2021 itself, including the effectiveness of bias mitigation measures implemented by funding bodies for the assessment panels. Crucially, they also provide an additional lens through which the wider engrained inequalities within research careers can be examined. These data will also provide a benchmark against which review and progress can be considered in any future exercise.

158. Overall, these analyses show a negative impact on likelihood of submission (i.e. employed in a role meeting Category A submission requirements), a negative impact on the number of outputs attributed and a negative effect on output scores across a range of groups under-represented in many areas of research. In many cases the effect size is small, however this is not the case in all instances.

159. There are notable impacts in terms of the likelihood of submission for some groups. The likelihood of submission for Black staff was lower than that of White to a statistically significantly extent, both at exercise level and across all main panels. Disabled staff were also statistically significantly less likely to have been submitted at exercise and all main panel levels. There was also a statistically significant negative effect observed for submission of female staff across three of the main panels, although this variation was not significant at the aggregated exercise level.

160. For the number of outputs attributed, there was a statistically significant negative effect for females and disabled staff at exercise level and across all main panels. For Black staff a negative effect across two of the main panels was also statistically significant.

161. For all analysed groups the effects on scoring are not statistically significant at exercise level and in the majority of the analyses, differences are not statistically significant at main panel level either. However, the exception is for sex, where a statistically significant negative effect for female staff was observed for two of the main panels.

162. The outcomes at exercise and main panel level in part reflect the great variability observed in effects across individual UOAs for different characteristics. This highlights the complexity of the picture and draws some of the limitations into sharper focus. For instance, it is clear that very small numbers make it difficult to

draw reliable conclusions for some groups at UOA level. It is important to consider that the number of staff returning data on protected characteristics, as collected through the HESA staff return, can be very small when broken down to more granular levels. This particularly impacts the ability to undertake intersectional analysis, or to report on results for certain sub-sets of under-represented groups. Moreover, the significance of the effects within these analyses are highly determined by the sample size and the specific incidence of the characteristic under analysis. It also introduces challenges in seeking to control for the wide range of variables that may have a confounding effect on the outcomes observed – including output type, where analysis has shown differences in the proportions of the highest-quality outputs between the different output types.

163. Another limitation of this study is around the issue of co-authorship. The majority (over 70%) of the total outputs submitted in REF 2021 had one or more co-authors. The submission process required each output to be attributed to one staff member only, on the basis of which data was drawn for this study on that author's characteristics. However, we do not hold any information about the characteristics of the remaining co-author(s) or information about the decisions taken by submitting institutions on who to attribute to which output in cases where multiple staff may have been attributable.

164. The effect of individuals with more than one output attributed to them may also require more consideration – current staff could have between one and five outputs attributed to them in submissions. The analysis in this report made a key assumption that outputs attributed to the same author were independent. However, analysis of outputs at Exercise level indicates a likely relationship between number of outputs attributable to one staff member and quality, with higher scores on average observed for those outputs that were one of multiple attributed to one staff member. This is not in itself surprising, given the likely submission strategy of participating institutions to maximise the submission of the highest-quality outputs within the flexibility afforded by the decoupling of staff and outputs. Evidence also suggests likely differences in representation by protected group of staff with multiple outputs attributed to them.

165. EDAP's review of institutional Equality Impact Assessments (EIAs) provides some insight into this. While inconsistencies in data reporting made it difficult to draw general conclusions in many areas, the report highlights that 'a good proportion of institutions reported an under-representation of outputs allocated to female authors, as well as a significant under-representation of female staff having four or five outputs allocated to them'[21].

166. Under-representation in submission processes is also observed in differences between groups in the proportion of staff identified with significant responsibility for research out of the total eligible pool. As also highlighted through EDAP's review of EIAs, around half of the institutions carried out an analysis comparing their

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[21] https://www.ref.ac.uk/publications-and-reports/equality-and-diversity-advisory-panel-final-report/, p.22.

submitted population with their eligible population. Of these, the vast majority reported an under-representation of female staff in the submitted population.

167. In seeking to understand some of the trends across the analyses undertaken post-REF 2021 outcomes, we can find some reflection on this from institutions themselves. As EDAP also highlighted in their report, several institutions noted that the under-representation was not necessarily due to the impact of REF processes, but rather that the exercise highlighted existing structural inequalities that were common in the sector. One observed that 'the selection of outputs, at the least, reinforces existing gender imbalances'[22].

168. More widely, the outcomes observed in this study can be situated in the wider evidence base about inequalities in research careers. This ranges from the stark picture painted by data on increasing under-representation of some groups through the research career stages[23] through to evidence about differences in key areas of research activity and performance, such as grant funding, citations and so on, that collectively highlight the structural inequalities permeating the research landscape[24].

169. The analysis undertaken for this study does not provide an insight into the cause of the negative effects observed. The evidence we have from related analyses and feedback from institutions suggests that the outcomes observed here reflect entrenched issues with inequality, marginalisation and under-representation that feed in multiple ways into the submission and assessment processes for REF. Although the analysis reported here does not provide any evidence either way on the issue, bias in the assessment process itself may be a factor here – although it is important to note the limited access to data about attributed authors that panels had access to (primarily surname and initial). Nonetheless, it will be important for the funding bodies to reflect on ways in which the bias mitigation measures introduced for REF 2021 can be built on further in future exercises – as well as how the framework itself can continue to encourage and promote EDI in research careers.

170. Finally, while these analyses are a welcome addition to the range of reports evaluating REF 2021, more should be done in future to undertake intersectional analyses to more accurately understand and represent the experiences of researchers from one or more under-represented groups. Future research assessment exercises should aim to replicate and build on the analyses presented in this report, to consider whether any improvement has been made from REF 2021 to the conclusion of the next Research Excellence Framework.

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[22] https://www.ref.ac.uk/publications-and-reports/equality-and-diversity-advisory-panel-final-report/, p.22.
[23] https://www.ucu.org.uk/media/7861/The-experiences-of-black-and-minority-ethnic-staff-in-further-and-higher-education-Feb-16/pdf/BME_survey_report_Feb161.pdf
[24] Wellcome final version short report BG May 2017 (squarespace.com)

Annex A: Definitions and abbreviations

Category A eligible staff - Academic staff with a contract of employment of 0.2 FTE or greater, on the payroll of the submitting institution on the census date (31 July 2020), whose primary employment function is to undertake either 'research only' or 'teaching and research'. Staff must have a substantive connection with the submitting institution. Staff on 'research only' contracts were required to meet the definition of an independent researcher. Staff meeting these criteria formed the total eligible staff pool but were not necessarily submitted.

Category A submitted staff - Category A eligible staff who were identified as having significant responsibility for research on the census date.

Code of Practice - Each institution making a submission was required to develop, document and apply a code of practice for determining which staff met the criteria of being an independent researcher and the selection of outputs in their REF submissions. Institutions not submitting 100% of Category A eligible staff were required to include the criteria and processes for identifying staff with significant responsibility for research.

Double-weighting - Institutions were able to request that outputs of extended scale and scope be double-weighted (count as two outputs) in the assessment.

Early Career Researcher (ECR) - For the purposes of REF 2021, ECRs are defined as members of staff who meet the definition of Category A eligible on the census date, and who started their careers as independent researchers on or after 1 August 2016[25].

HEI: A Higher Education Institution.

Higher Education Statistics Agency (HESA) - HESA, the Higher Education Statistics Agency, are the experts in UK higher education data, and the designated data body for England. HESA collect, assure and disseminate data about higher education in the UK, working with HE providers in each of the four nations[26].

Main panel: Four main panels, each covering a broad disciplinary area[27], held responsibility for coordinating and overseeing the work of their respective of sub-panels for the development of criteria and the assessment of submissions within REF 2021.

Outputs - Outputs are the published or publicly available products of research, which can take many forms. These include books, monographs, chapters in books and journal articles as well as performances, exhibitions and other practice research outputs, software, patents, conference proceedings, translations, and digital and visual media.

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[25] For more detail on ECRs and research independence see paragraphs 148-149 of the Guidance on Submissions document: https://www.ref.ac.uk/publications-and-reports/guidance-on-submissions-201901/
[26] For more information please see: https://www.hesa.ac.uk/about
[27] See Annex B for further detail.

Significant responsibility for research - Staff with significant responsibility for research were those for whom explicit time and resources are made available to engage actively in independent research, and for which that is an expectation of their job role.

Staff circumstances - Measures to take account of the effect of individuals' circumstances on research productivity during the period. These measures enabled HEIs to request an optional reduction in the unit's output requirement. They also allow an individual to be returned without the required minimum of one output without penalty in the assessment, where circumstances had an exceptional effect on productivity, such that the staff member had not been able to produce an eligible output in the assessment period.

Submission - A submission comprises a complete set of data about staff, outputs, impact and the research environment, returned by an HEI in any of the 34 UOAs

Sub-panel – In each of the 34 disciplinary UOAs, an expert sub-panel, comprising academic and research user members, were appointed to undertake assessment of submissions under the guidance and oversight of the four main panels.

Unit of Assessment (UOA) - One of 34 discipline areas to which REF 2021 submissions may have been made by an HEI.

Annex B – REF 2021 main and sub-panel structure

Main Panel	Unit of assessment	
A	1	Clinical Medicine
	2	Public Health, Health Services and Primary Care
	3	Allied Health Professions, Dentistry, Nursing and Pharmacy
	4	Psychology, Psychiatry and Neuroscience
	5	Biological Sciences
	6	Agriculture, Food and Veterinary Sciences
B	7	Earth Systems and Environmental Sciences
	8	Chemistry
	9	Physics
	10	Mathematical Sciences
	11	Computer Science and Informatics
	12	Engineering
C	13	Architecture, Built Environment and Planning
	14	Geography and Environmental Studies
	15	Archaeology
	16	Economics and Econometrics
	17	Business and Management Studies
	18	Law
	19	Politics and International Studies
	20	Social Work and Social Policy
	21	Sociology
	22	Anthropology and Development Studies
	23	Education
	24	Sport and Exercise Sciences, Leisure and Tourism
D	25	Area Studies
	26	Modern Languages and Linguistics
	27	English Language and Literature
	28	History
	29	Classics
	30	Philosophy
	31	Theology and Religious Studies
	32	Art and Design: History, Practice and Theory
	33	Music, Drama, Dance, Performing Arts, Film and Screen Studies
	34	Communication, Cultural and Media Studies, Library and Information Management

Annex C: Details on methodology

Background

i. This annex relates to statistical-significance testing of the effect of characteristics of interest on likelihood of submission, number of outputs attributed and output scoring in REF 2021. The methodology for these analyses are outlined over two sections, below. The analysis was undertaken in two stages to identify differential effects for researchers within the REF eligible population, in terms of inclusion, attribution and scoring in REF 2021, on the basis of protected and other characteristics.

a) The first section covers analysis of staff submission against the eligible population and attribution of outputs to submitted staff against staff characteristics. This is to identify any effects of these characteristics on (i) submission to REF 2021 and, (ii) attribution of outputs to submitted staff.

b) A second section covers the analysis of effects on REF panel scoring against characteristics of attributed staff.

Section A: Analysis of submission of Category A submitted staff compared to Category A eligible staff, and output attribution by characteristics of interest

1. **Data**

1.1. The eligible population data is drawn from the 2019-20 HESA staff dataset completed by HEIs, adjusted by the data corrections process undertaken post REF submission, to allow HEIs to correct any errors identified between the HESA dataset and REF submissions data. This provides a baseline (headcount) population of those meeting the eligibility criteria. All staff from units granted a small unit exception, due to unit size, were removed from the eligible population, through identification via the approved exception table of the REF submission database. These details including UKPRN, staff ID and UOA were matched against HESA data for the eligible population and the removed.

1.2. Data on characteristics of staff were taken from the HESA 2019-20 staff return. The data for analysis included of 105,667 eligible staff (Category A eligible).

1.3. The submitted staff population is drawn from the submitted data for staff meeting all submission criteria including significant responsibility for research, who were submitted to REF 2021 (Category A submitted). These were matched to the corrected HESA 2019-20 staff record using their HESA staff ID to identify characteristics of interest. 81,167 staff were Category A submitted, with 24,500 unsubmitted. Of the Category A submitted staff, 80,439 were submitted with a HESA ID, however 57 of these were not able to be matched with the HESA data. Therefore, 80,382 submitted staff were matched to the HESA data, to identify protected and other characteristics of interest. 250 staff were submitted with no outputs attributed.

1.4. The analysed dataset contained, for each staff member

a) submission indicator
b) number of outputs submitted
c) percentage of FTE for each researcher (if >0.2)
d) Unit of Assessment (UOA)
e) Main Panel (A, B, C or D)
f) Protected, and other characteristics of interest.[28]

Assumptions and limitations

1.5. *Eligible data unmatched to HESA:* 785 submitted staff could not be matched due to missing (728) or non-matching HESA IDs (57). These could not be differentiated from the eligible unsubmitted staff . This assumes that any bias introduced by submitted unmatched staff (<1% of those submitted staff matched to HESA) will be minor.

1.6. *Output count:* Two data issues were identified with the number of outputs that each researcher submitted.

   a) For those unmatched to HESA data, the dataset assumed zero outputs and they are indistinguishable from unsubmitted.

   b) 250 researchers were part of the submissions but did not provide any outputs with all other submitted staff providing at least one output.

1.7. The distribution of number of outputs across the eligible population is shown in Figure A below.

Figure A: distribution of outputs across the eligible population
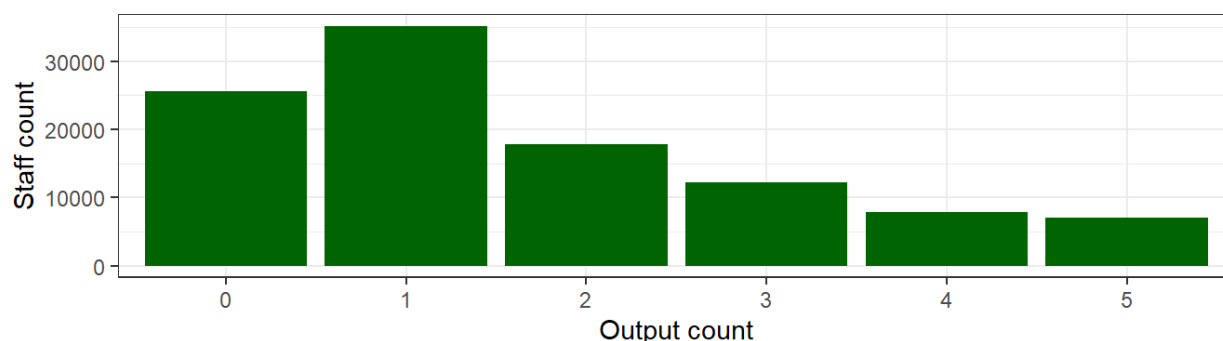
1.8. *Full Time Equivalent (FTE)*: The eligible pool includes staff with FTE equal to or greater than 0.2. All FTE was between 0.2 and 1. 26% of unsubmitted staff were part-time compared to 13% of submitted staff matching to the HESA data.

1.9. FTE is included as a simplified dichotomous variable: Full Time vs. Not Full Time, to simplify interpretation of the analysis. The distribution of those not full time (FTE < 1) is shown in Figure B below.

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[28] For the *gender identity* characteristic, the analysis is undertaken against the HESA *gender reassignment* field, which records the gender identity of the member of staff, on the basis of their own self-assessment. The field identifies whether the current gender identity is that assigned at birth.

Figure B: distribution of FTE < 1 by FTE
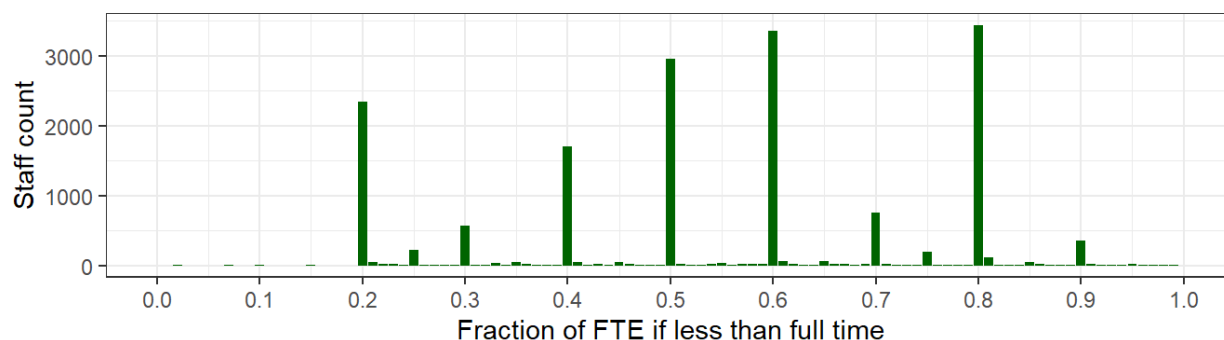
1.10. *Missing data:* **Missing values in the variables are shown in Table B.**

Table B: missing variables

variable	n_missing
sex_identifier	45
age	30
ecr	0
sexual_orientation	50,660
forty_five_plus	30
age_less_than_thirty	30
gender_reassignment	0
disability	0
ethnicity	45
religion	51,855
ukprn	0
main_panel	0
UOA	55
output_count	0
parental_leave1	0
fte	0

Table and figures adjusted following HESA rounding rules

i. For *gender reassignment* the data had 73,765 missing values. Missing values were classified as a No response and the variable was included for analysis.

ii. A significant amount of data was missing for *sexual orientation* and *religion and belief*, which could not be allocated to any of the named groupings for these variables. Both variables were excluded from the analysis as data could not be considered reliable enough to model the results.

iii. 45 missing *sex* identifiers were excluded from the model on the basis that this would not affect the overall results significantly due to the small relative size of this group.

iv. For *disability*, missing values were coded as 'Unknown'.

v. The analysis assumes for Parental leave where 1 is null, that the staff member has not taken parental leave.

1.11. Note that varying sample sizes across the characteristics will affect the confidence intervals shown in the analysis.

Methodology

2. Analytical models

2.1. The analysis aimed to assess differences in likelihood of submission to REF across different groups of staff by protected and other characteristics of interest, and to determine any differential effects on the number of outputs attributed to submitted staff across these groups.

2.2. The characteristics considered were:

- *sex*
- *disability*
- *ethnicity*
- *age*
- *ecr (early career researcher)*
- *gender identity*
- *parental leave*

2.3. To undertake these analyses two analytical models were created: one model to assess the effect on submission likelihood and one model to assess the number of outputs if larger than zero.

a) A separate instance of each model was fitted to the data for each of the four Main Panels (A, B, C and D). The main panel analyses were aggregated to achieve a whole exercise-level output for each of the two models.

b) The large sample sizes involved ensures that this analytical approach can be seen to be robust, however it should be noted that, in terms of statistical significance, large sample sizes across some groupings will make the standard errors for estimating the effects small. Consequently, while some estimates of variation are likely to be statistically significant, some judgement is needed in considering whether these are meaningful variations.

3. Submitted vs. not submitted model

3.1. As the outcome (submitted/not submitted) was dichotomous, a logistic regression was used as an appropriate approach to assess the relationship of the outcome variable with each explanatory variable in the presence of more than one explanatory variable. This allows avoidance of confounding effects by analysing the association of all variables together.

Outcome variable:

- *submitted* (the indicator for being included in a submission)

Explanatory variables:

- *sex*

- *disability*
- *ethnicity*
- *age*
- *ecr (early career researcher)*
- *gender reassignment*
- *parental leave*
- *full time*
- *full time x sex*

3.2. Interactions were considered between *full time* and *sex*, which identified a relationship between these variables

3.3. 95% confidence intervals were used with an adjustment for multiple comparisons using Bonferroni and all possible combinations within each variable. Confidence intervals were built directly from the model outputs for each main panel, the total confidence intervals at whole exercise-level were built by simulating the data based on the main panel intervals.

3.4. The analysis predicts the probability for each characteristic of being included for submission keeping all other factors static, with the odds ratio of submission for each specific characteristic compared to a "base" characteristic for comparison (e.g. for female as the specific characteristic this is compared to the base characteristic of male). For age, the analysis modelled the effect of an individual's current age compared to their current age plus 10 years and the chart represents the average effect for all ages.

3.5. This odds ratio indicates how many times more likely it is for the characteristic of interest to be included for submission compared to the base characteristic. In the chart below (Figure C) the confidence interval range for each characteristic is represented by the black line, and the calculated odds ratio for submission by the position of the black dot along that line.

Figure C: Impact of characteristics on likelihood of submission at exercise level
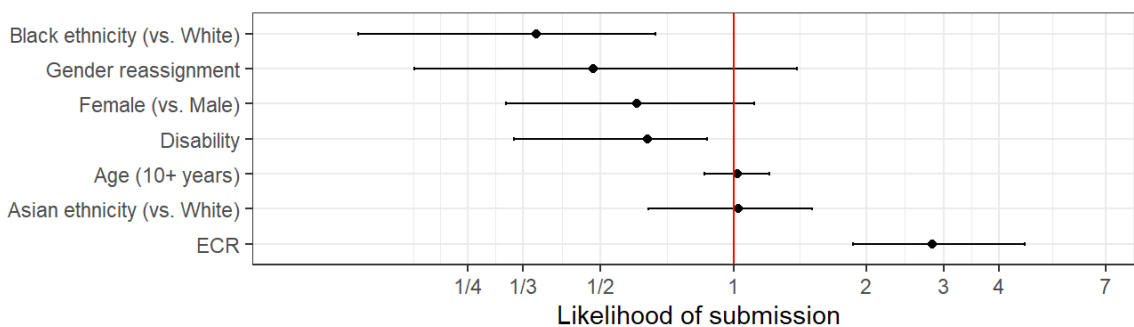
3.6. An odds ratio of 1 (highlighted by the central red line) indicates that both the characteristic of interest and the base had equal likelihood of being submitted. Where the confidence interval includes the value 1 (i.e. if the confidence interval crosses the red line at 1) this indicates that it is plausible that the observed effects may be caused by chance, and are not statistically significant. Where the confidence interval does not include 1 this indicates a statistically significant effect for the characteristic as compared to the base, either positively or

negatively. The X axis is presented in a logarithmic scale to fairly represent the size of the intervals each side of 1.

3.7. For example, for Black ethnicity this shows that a Black member of staff is in average between 1/2 and 1/3 as likely to be included in a submission compared to a White member of staff, and this difference is statistically significant. The odds ratio for female staff as compared to male is calculated as being between 1 and 1/2 as likely, but that this is not a statistically significant effect. For ECR there is a statistically significant positive effect observed.

3.8. Note that for age, the analysis modelled the effect of an individual's current age compared to their current age plus 10 years, and the chart represents the average effect across all ages.

4. Attribution of outputs model

4.1. To explain the relationship between the characteristics of interest and number of outputs attributed a proportional odds linear regression was used. This is a type of generalised linear model that looks at the effects of continuous and discrete variables onto an ordered categorical outcome variable. Other models considered included Negative Binomial and Poisson generalised linear models, however these were discarded as they are unbound, and with the number of some possible outputs modelled being greater than five.

4.2. The model specification was:

Outcome variable:

- *Number of outputs* (the indicator for outputs attributed)

Explanatory variables:

- *sex*
- *disability*
- *ethnicity*
- *age*
- *ecr (early career researcher)*
- *gender reassignment*
- *parental leave*
- *full time*
- *full time x sex*

4.3. Interactions were considered between full time and sex, which identified a relationship between the variables

4.4. The model calculates the odds of the output count changing against each of the explanatory variables. As with the submissions model, 95% confidence intervals were used with an adjustment for multiple comparisons. These confidence intervals were built from the model outputs for each main panel, with the total exercise level confidence intervals built by simulating the data based on the main panel intervals.

4.5. The interpretation of the odds ratio assumes that the proportional odds assumption holds, which means that the odds ratios are constant across all levels of the outcome variable.

4.6. The analysis predicts the **average number of outputs** for each characteristic keeping all other factors the same, with the **odds ratio of the number of outputs for a specific characteristic** compared to a base characteristic. This indicates how likely the assessed characteristic it is to get at a higher number of outputs compared to the base characteristic. For age, the analysis modelled the effect of an individual's current age compared to their current age plus 10 years and the chart represents the average effect across all ages.

4.7. In the chart (Figure D) below the confidence interval range for each characteristic is represented by the black line, and the calculated odds ratio of higher output attribution by the position of the black dot along that line.

Figure D: Impact of characteristics on output attribution at exercise level
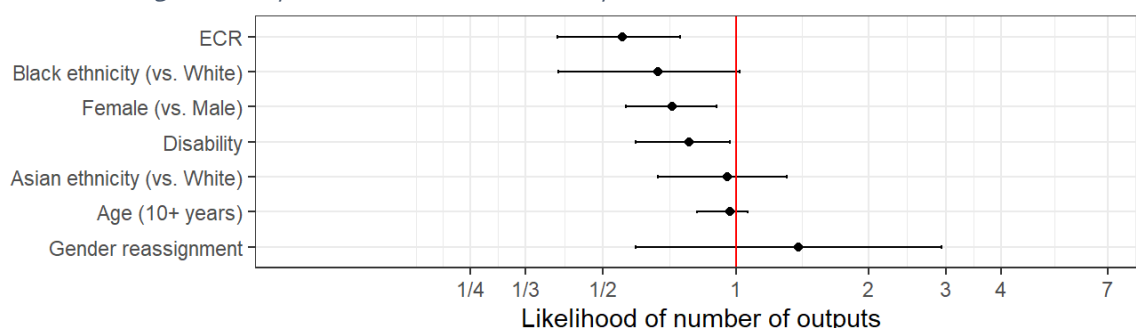
4.8. An odds ratio of 1 indicates that both the characteristic of interest and the base had equal likelihood of a higher number of outputs being attributed. Where the confidence interval includes the value 1 this indicates that it is plausible that the observed effects may be due to chance and are not statistically significant. Where the confidence interval does not include 1 this indicates a statistically significant effect for the characteristic as compared to the base, either positively or negatively. The X axis is presented in a logarithmic scale to fairly represent the size of the intervals each side of 1.

Section B: Analysis of output scores

1. Data

1.1. The dataset for analysis was 175,648 outputs submitted to REF 2021. Output data were matched to the HESA 2019/20 staff data to obtain the protected and other characteristics of interest of the attributed author.

1.2. Of the overall number of submitted outputs, 4,240 which could not be matched to the HESA data were excluded. The analysis assumes no bias from the removal of these outputs - the relative size of the removals also limits the possible effect that any bias arising may have on the results. The analysis was undertaken against 171,408 outputs.

1.3. The characteristics considered were:

- *sex*
- *disability*
- *ethnicity*
- *age*
- *ecr*
- *gender identity*
- *parental leave*

1.4. The data identified 34 Units of Assessment (UOA) where each submission was scored on a scale from zero to four.

1.5. The analysis was undertaken on final output scores, as recorded by the assessment panel for each item. Scores were assigned to outputs directly, and not to the attributed authors themselves.

2. Methodology

2.1. A linear regression with the variables of interest was fitted to each of the 34 UOAs to assess the effect of the characteristics on the score, and to find the distribution of the effect of each characteristic on the average score for each UOA. This allowed an understanding of the distribution of these data at this level and when aggregated by main panel and across the exercise in total. Each of the 34 regression models had the same structure and variables.

2.2. The coefficients of the regression provide the effect of each characteristic by UOA. The scores were discrete and bound between zero and four, however for analysis the regressions assumed continuous scores.

2.3. To estimate the uncertainty of these coefficients, a thousand bootstrapped samples of the original dataset with the original size and structure by UOA were taken and for each sample and regressions for each UOA fitted. This provided a thousand coefficients per UOA and characteristic, which were used to calculate their average (median) and a 95% central mass interval.

2.4. Some of the characteristics had a low prevalence by UOA. Where less than 30 cases were present the results were excluded from the analysis as data were insufficient to provide a reliable distribution. However, these data were used for the main panel and exercise level analysis.

2.5. To aggregate the results for the main panel (A, B, C or D) and the exercise level totals, scores were simulated for each UOA based on their UOA level samples. These simulations were done by bootstrapping samples by UOA with their respective weights. The samples were then combined to create the distribution for the main panels and the exercise level total, and 95% central percentile intervals were produced. Whilst intervals by UOA provide the expected value for their average within the UOA, the aggregate (by panel or total) intervals capture the volatility of the averages between different UOAs.

3. Assumptions and limitations

3.1. Outcomes submitted by the same individual were assumed to be independent, that is, even if up-to five outcomes came from the same person the effect of the person was not modelled.

3.2. Significance refers to the fact that the 95% interval did not include zero; that would mean no impact compared to the base effect. Note that the magnitude of the effects vary substantially by characteristic.

3.3. The significance of the effects by UOA is highly determined by the sample size and the specific incidence of the characteristic under analysis. For example, for *gender reassignment* incidence is very small which provides a large level of uncertainty on the average effects.

3.4. The aggregate results combine the uncertainty by UOA. By looking at the aggregate intervals there is a strong implicit assumption that outcomes from each UOA are independent.

4. Analytical model

4.1. All models across all UOAs used the same structure[29] with the model specification:

Outcome variable:

- *score*

Explanatory variables:

- *sex*
- *disability*
- *ethnicity*
- *age*
- *ecr*
- *gender reassignment*
- *parental leave*

4.2. *Religion and belief* and *sexual orientation* were excluded from the analysis based on the quality and granularity of the available data.

4.3. For each characteristic the chart below (Figure E) shows the variability of effect at exercise level. The difference between scores is represented on the 0-4 scale for the reference group for each characteristic and the group of interest (x axis). 0 represents no difference in score between the reference group and group of interest, whereas -1 means a difference of -1 on the 0-4 scale.

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[29] *Note that some models excluded one or more variables if their bootstrapped sample had no internal variability*

Figure E: score effects by characteristic at whole exercise-level
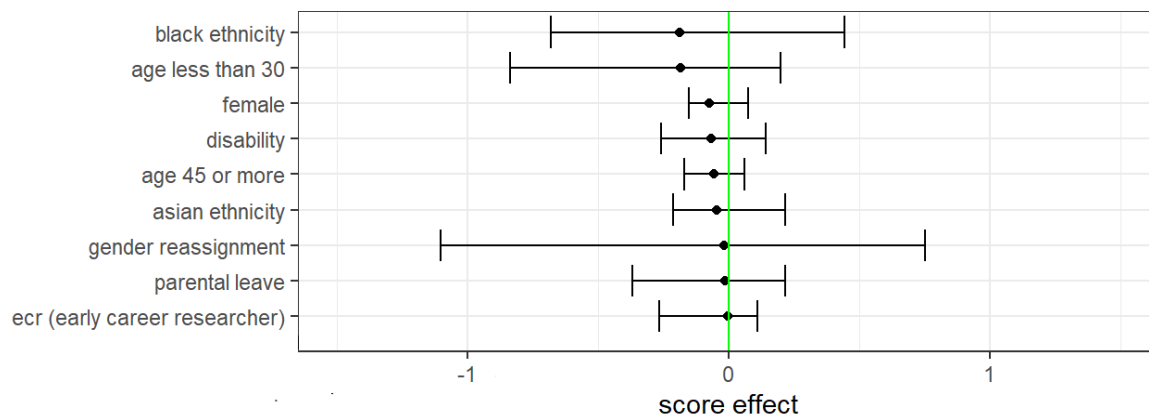
4.4. The uncertainty for the total represented by the black lines uses the central 95% confidence interval from data simulated using the 34 UOA expected scores.

4.5. At exercise level, across all characteristics examined, the median score effect (black dot) is negative (to differing extents), indicating lower observed scores for the group of interest in comparison to the reference group. None of the differences observed at this level were determined to be statistically significant at the 95% level.

Annex D – Staff submission by characteristic, by TRAC group

The tables below provide a summary of the eligible and submitted populations for REF 2021 by characteristic of interest and by TRAC group. These data have been adjusted to in line with HESA rounding rules.

Figure 1: Eligible and submitted population by TRAC group and age group

	Age	TRAC GROUP							Total
		A	B	C	D	E	F	(blank)	Total
Eligible	18-24	-	-	5	20	10	-	-	40
	25-34	4,320	1,375	1,575	1,895	1,220	250	5	10,640
	35-44	15,780	4,675	4,725	4,705	3,250	725	20	33,880
	45-54	13,535	4,120	5,215	5,135	3,855	810	45	32,715
	55+	11,700	3,295	4,950	4,350	3,370	690	35	28,385
	Unknown	-	-	-	-	-	-	-	5
Submitted	18-24	-	-	-	-	-	-	-	-
	25-34	4,280	1,355	810	760	590	60	-	7,860
	35-44	15,690	4,610	2,980	2,255	1,745	310	-	27,595
	45-54	13,505	4,035	2,715	2,060	1,650	380	10	24,350
	55+	11,665	3,215	2,295	1,620	1,430	340	5	20,575
	Unknown	-	-	-	-	-	-	-	-
Total Eligible		45,340	13,475	16,475	16,095	11,705	2,475	105	105,665
Total Submitted		45,140	13,220	8,805	6,695	5,415	1,090	20	80,380

Figure 2: Eligible and submitted population by TRAC group and disability

	Disability	TRAC GROUP							Total
		A	B	C	D	E	F	(blank)	Total
Eligible	No	42,155	12,835	15,330	14,965	10,580	2,145	100	98,115
	Yes	1,490	445	870	730	825	220	5	4,580
	Unknown	1,690	195	275	405	300	105	-	2,970
Submitted	No	41,970	12,600	8,275	6,305	4,960	985	20	75,115
	Yes	1,490	425	395	230	320	90	-	2,950
	Unknown	1,680	190	130	160	135	15	-	2,315
Total Eligible		45,340	13,475	16,475	16,095	11,705	2,475	105	105,665
Total Submitted		45,140	13,220	8,805	6,695	5,415	1,090	20	80,380

Figure 3: Eligible and submitted population by TRAC group and ECR status

	ECR	TRAC GROUP							Total
		A	B	C	D	E	F	(blank)	Total
Eligible	No	38,420	11,450	14,785	14,275	10,350	2,320	105	91,700
	Yes	6,915	2,025	1,690	1,820	1,355	155	5	13,965
	Unknown	-	-	-	-	-	-	-	-
Submitted	No	38,235	11,195	7,495	5,610	4,600	985	20	68,135
	Yes	6,905	2,020	1,310	1,080	820	105	-	12,245
	Unknown	-	-	-	-	-	-	-	-
Total Eligible		45,340	13,475	16,475	16,095	11,705	2,475	105	105,665
Total Submitted		45,140	13,220	8,805	6,695	5,415	1,090	20	80,380

Figure 4: Eligible and submitted population by trac group and ethnicity

	Ethnicity	A	B	C	D	E	F	(blank)	Total
					TRAC GROUP				
Eligible	White	35,145	10,395	12,985	12,595	9,785	1,890	90	82,890
	Black	370	150	540	610	300	45	-	2,010
	Asian	3,980	1,485	1,540	1,635	795	80	10	9,520
	Mixed	870	255	375	355	255	70	-	2,180
	Arab	135	50	100	95	60	10	-	450
	Other	715	265	300	255	135	35	5	1,705
	Unknown	4,125	875	635	550	380	345	5	6,910
Submitted	White	35,015	10,165	6,750	5,180	4,365	890	15	62,385
	Black	365	150	240	190	125	10	-	1,075
	Asian	3,960	1,475	955	755	475	30	-	7,645
	Mixed	865	255	235	160	130	30	-	1,675
	Arab	135	45	60	50	35	5	-	330
	Other	715	265	195	125	85	20	-	1,405
	Unknown	4,090	865	380	235	200	100	-	5,875
Total Eligible		45,340	13,475	16,475	16,095	11,705	2,475	105	105,665
Total Submitted		45,140	13,220	8,805	6,695	5,415	1,090	20	80,380

Figure 5: Eligible and submitted population by trac group and gender identity

	Gender assigned at birth	A	B	C	D	E	F	(blank)	Total
					TRAC GROUP				
Eligible	Yes	12,265	3,305	5,550	4,175	3,040	435	-	28,765
	No	95	15	35	15	260	10	5	435
	Unknown	32,975	10,155	10,890	11,905	8,405	2,030	100	76,465
Submitted	Yes	12,215	3,180	2,870	1,570	1,435	215	-	21,490
	No	95	15	15	10	70	-	5	210
	Unknown	32,830	10,025	5,920	5,110	3,910	870	15	58,685
Total Eligible		45,340	13,475	16,475	16,095	11,705	2,475	105	105,665
Total Submitted		45,140	13,220	8,805	6,695	5,415	1,090	20	80,380

Figure 6: Eligible and submitted population by trac group and parental leave within the previous year

	Parental Leave	A	B	C	D	E	F	(blank)	Total
					TRAC GROUP				
Eligible	Yes	510	190	230	175	215	20	5	1,340
	No/Unknown	44,830	13,285	16,245	15,920	11,490	2,455	105	104,330
Submitted	Yes	510	185	150	90	105	10	-	1,050
	No/Unknown	44,635	13,030	8,655	6,605	5,310	1,080	20	79,335
Total Eligible		45,340	13,475	16,475	16,095	11,705	2,475	105	105,665
Total Submitted		45,140	13,220	8,805	6,695	5,415	1,090	20	80,380

Figure 7: Eligible and submitted population by trac group and religion or belief

	Religion or belief	TRAC GROUP							Total
		A	B	C	D	E	F	(blank)	
Eligible	No religion	10,150	2,235	3,800	2,350	2,780	825	-	22,140
	Buddhist	205	45	95	60	80	15	-	500
	Christian	5,355	1,610	2,805	2,165	2,955	230	-	15,120
	Hindu	340	80	150	100	95	5	-	770
	Jewish	305	60	100	30	45	25	-	560
	Muslim	455	145	380	270	235	15	-	1,505
	Sikh	35	5	30	40	25	5	-	140
	Other	835	140	390	180	320	70	-	1,940
	Unknown	27,660	9,155	8,720	10,900	5,170	1,290	105	63,000
Submitted	No religion	10,105	2,185	2,355	1,030	1,285	395	-	17,350
	Buddhist	205	40	50	20	40	5	-	365
	Christian	5,330	1,470	1,360	655	980	90	-	9,880
	Hindu	335	80	90	30	45	-	-	580
	Jewish	300	55	65	15	20	15	-	475
	Muslim	455	140	215	120	110	5	-	1,045
	Sikh	35	5	10	10	5	-	-	70
	Other	835	140	195	70	155	25	-	1,420
	Unknown	27,545	9,095	4,465	4,750	2,775	545	20	49,190
Total Eligible		45,340	13,475	16,475	16,095	11,705	2,475	105	105,665
Total Submitted		45,140	13,220	8,805	6,695	5,415	1,090	20	80,380

Figure 8: Eligible and submitted population by trac group and sex

	Sex	TRAC GROUP							Total
		A	B	C	D	E	F	(blank)	
Eligible	Male	29,015	8,460	8,525	8,125	5,625	1,225	45	61,020
	Female	16,215	4,995	7,940	7,960	6,065	1,250	60	44,485
	Other	105	15	10	5	15	-	-	150
	Unknown	5	-	-	5	-	5	-	15
Submitted	Male	28,910	8,345	5,105	3,830	2,950	540	10	49,690
	Female	16,120	4,855	3,695	2,855	2,460	550	10	30,550
	Other	105	15	5	5	5	-	-	135
	Unknown	5	-	-	5	-	-	-	10
Total Eligible		45,340	13,475	16,475	16,095	11,705	2,475	105	105,665
Total Submitted		45,140	13,220	8,805	6,695	5,415	1,090	20	80,380

Figure 9: Eligible and submitted population by trac group and sexual orientation

	Sexual Orientation	TRAC GROUP							Total
		A	B	C	D	E	F	(blank)	
Eligible	LGB	1,105	290	510	405	355	255	-	2,920
	Heterosexual	15,925	4,290	7,290	5,935	6,045	865	5	40,355
	Other	100	25	70	45	50	20	-	305
	Unknown	28,210	8,870	8,605	9,715	5,250	1,335	105	62,085
Submitted	LGB	1,100	275	295	185	165	170	-	2,190
	Heterosexual	15,855	4,130	3,985	2,275	2,455	325	5	29,030
	Other	100	25	45	25	30	10	-	235
	Unknown	28,090	8,790	4,480	4,205	2,765	585	15	48,925
Total Eligible		45,340	13,475	16,475	16,095	11,705	2,475	105	105,665
Total Submitted		45,140	13,220	8,805	6,695	5,415	1,090	20	80,380