Women and Peer Review

An audit of the Wellcome Trust's decision-making on grants

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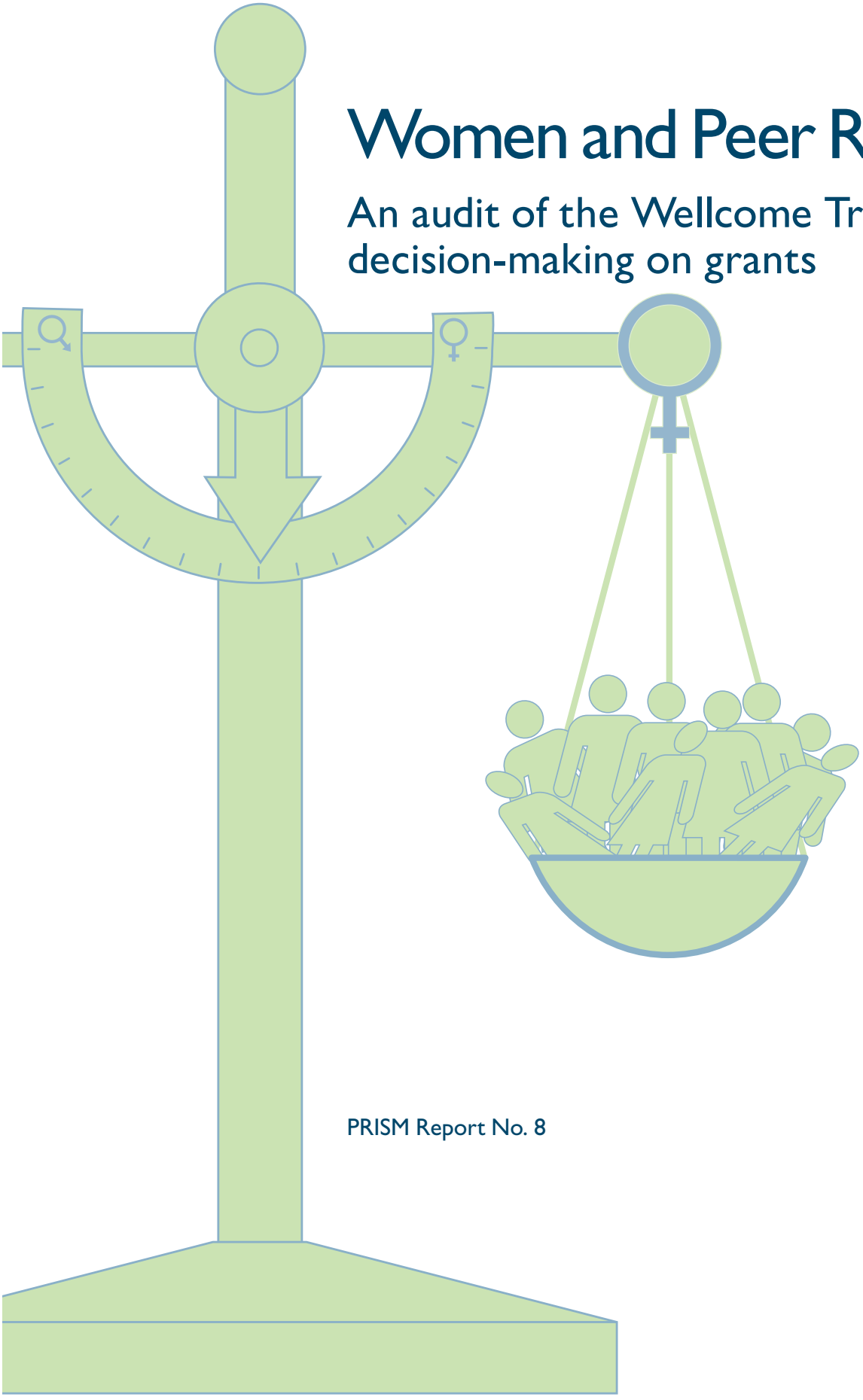

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EXECUTIVE SUMMARY

A recent study of peer-review scores for postdoctoral fellowships at the Swedish MRC demonstrated that women had to be 2.5 times more productive than their male colleagues to get the same peer-review rating for scientific competence.

We have audited the Wellcome Trust's decision-making on grants and demonstrated that there is no evidence of sex discrimination in the awarding of project grants, programme grants or Senior Research Fellowships in Basic Biomedical Science (SBBF):

- Award rates are about the same for men and women;
- Publication records of successful applicants are also similar.

There is evidence that women do not apply to the Trust for project or programme grants in the proportions that would be expected from the number of female academics working in UK universities. This is not the case for SBBF.

It is recommended that funding bodies should work together to identify the reasons why women do not apply for grants in the numbers expected.

1 INTRODUCTION

Over the past five years the issue of women in science has captured the policy agenda. Concern about the failure of women to advance to more senior grades in academia led to the establishment of a Committee on Women in Science and Engineering in 1993 which, in its report, *The Rising Tide,* made a number of recommendations aimed at increasing the number of women in science.[1] This was the impetus for an attitudes survey, published by the Wellcome Trust's Unit for Policy Research in Science and Medicine (PRISM), which highlighted factors that may be dissuading women from entering a scientific career.[2] More recently, a high-profile analysis of the peer-review system of the Swedish Medical Research Council (MRC) demonstrated that women suffer discrimination because of their sex. The authors proved that female applicants for Swedish MRC postdoctoral fellowships had to be 2.5 times more productive than their male colleagues to get the same peer-review rating for scientific competence.[3]

Given the results of the Swedish study, the objective of the current report is to examine whether there is inadvertent sex discrimination in the Trust's grant-giving practices by focusing on two questions:

1 *Are applications from women more likely to fail than from men?*
By examining successful and failed grant applications, we investigated whether applications to the Trust from women are more, or less, likely to fail than applications from men.

2 *Do women need to have a better publication record than men to win grants?*
We tested the hypothesis that women need to have a more impressive track record than men to be awarded grants by looking at the publication records of women whose applications are successful, and comparing them with men.

To answer these questions we examined applications to the Trust for project grants, programme grants and Senior Research Fellowships in Basic Biomedical Science (SBBF). These schemes were chosen as they represent the broad range of support provided by the Trust, and are aimed at scientists at different stages in their careers.

2 THE OUTCOME OF WELLCOME TRUST GRANT APPLICATIONS

2.1 PROJECT GRANTS, 1996

Project grants account for 33 per cent of all awards and 27 per cent of expenditure by the Trust in 1995/96.[a] Grants are normally made to holders of established posts in a university or institution (not to staff of, or fellows funded by, Research Councils) and typically provide support for up to three years.[4]

All project grant applications that were received by the Trust in 1996 were examined. Data on the sex,[b] age and past three academic addresses of successful and unsuccessful applications were recorded. Table 1 describes the outcomes of the 1387 applications on which information was collated.[c] The overall success rate is 27.5 per cent which is similar for women (26.9 per cent) and men (27.5 per cent). An alternative way of looking at Table 1 is to compare the proportion of female applicants with the proportion of women who succeeded and failed in their applications. For example, 19.3 per cent of applications (i.e. 268/1387 in Table 1) for project grants in 1996 were from women, compared to 18.9 per cent of awarded grants and 19.5 per cent of failed grants. In other words, there is no evidence that applications for project grants from women are more, or less, likely to fail than those from men.

The age and sex distributions of project grant applicants are graphically represented in the 'population pyramid' in Figure 1. The female population is on the left-hand side and the male population on the right, whilst the young are at the bottom and the old are at the top.[5] It is striking from Figure 1 that four times as many men apply, and are awarded, project grants as women. That is, for every 100 male applicants there are only 24 female applicants. The figure also shows that, whilst the sex ratio (the number of men divided by the number of women) broadly increases with age, the success rate for men and women is roughly the same for all but the youngest and two oldest age bands (where small numbers make the results inconclusive).

Table 1 The outcome of project grant applications

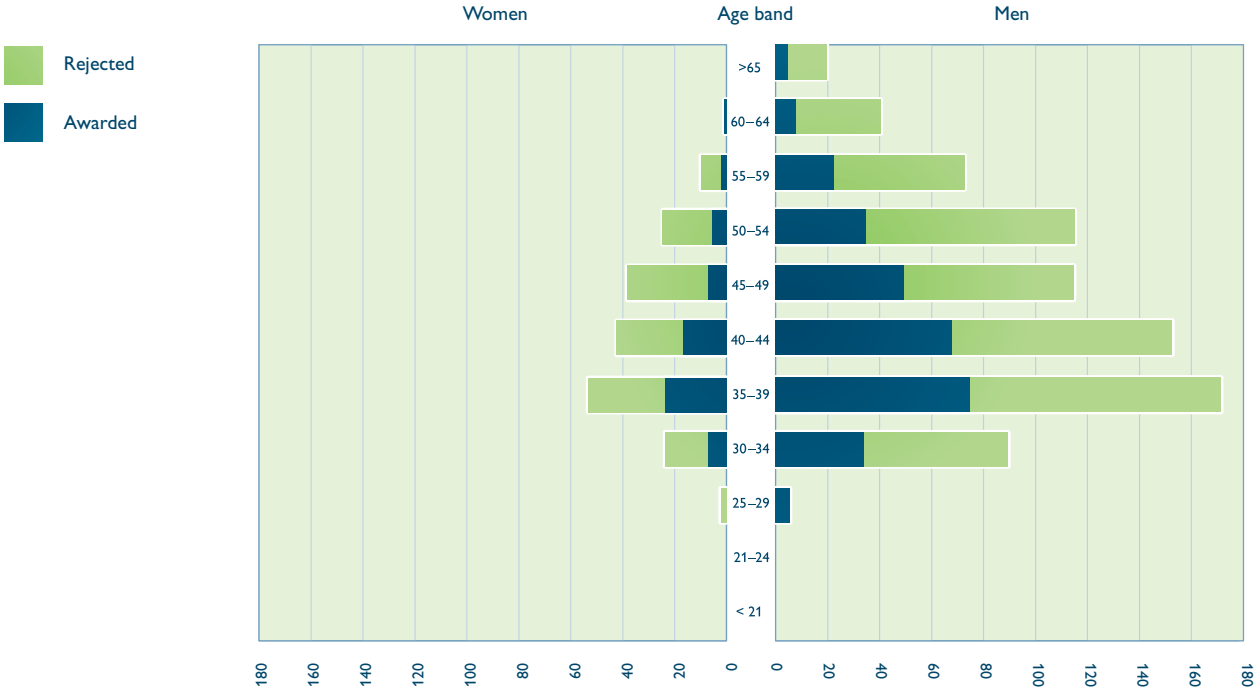
	Men	Women	Unsexed	Total
Number of applications	1097	268	22	1387
Number of successful applications	302	72	7	381
Success rate (%)	27.5	26.9	31.8	27.5

[a] The expenditure figure excludes a £60m grant for the Sanger Centre, a genome research centre set up in 1992 by the Wellcome Trust and the Medical Research Council.

[b] The sex of applicants was determined from their first name. Where recorders were unfamiliar with the name, it was noted and looked up on the Internet site, www.thebabynet.com. 'Unisex' names were shown to the Trust staff, and were classified only if the applicant's sex was known. The remaining names were classified as 'unsexed'.

[c] It should be noted that some project grant applications were missing as some files would have been on loan from the registry and omissions may have been made by the recorders. As long as there was not a systematic sex bias in the missing grant applications then the following results will not be compromised.

Figure 1: Numbers of rejected and awarded project grant applications by age and sex

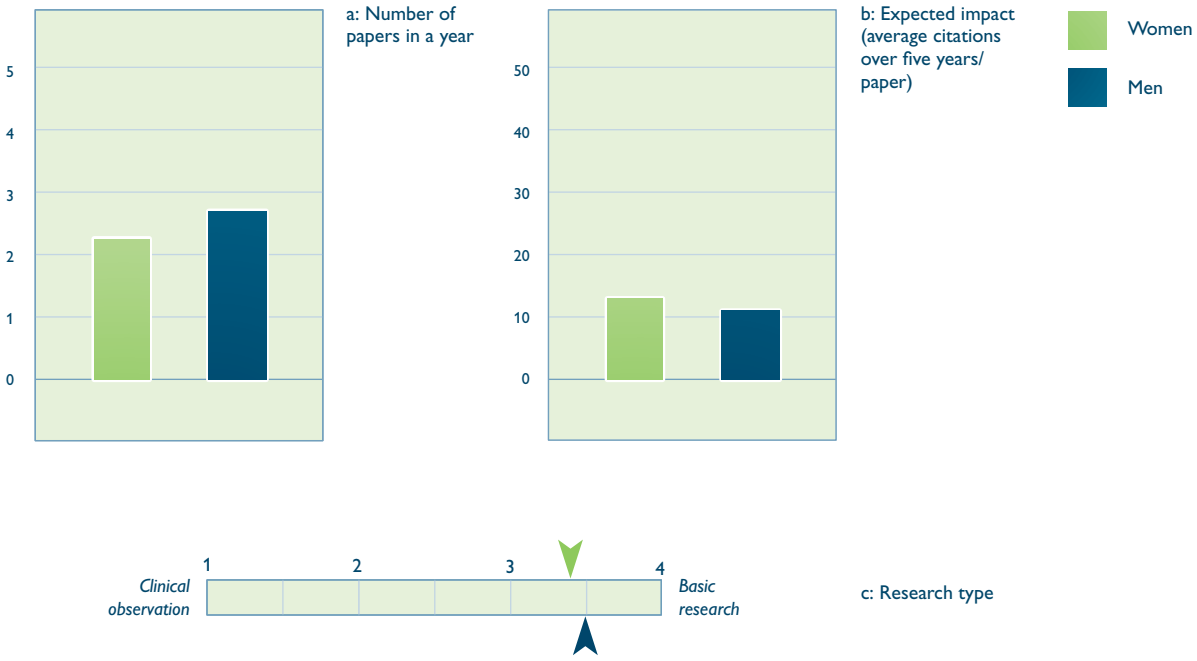


To examine whether women need to have a better publication record than men to win grants, the scientific papers authored by the applicants were collated from bibliographic databases. Detailed methods and results of these analyses are presented in the Annexes (pp. 18–20). The publication records of a sub-sample of 25 male and 25 female project grant applicants are summarized in Figure 2 and illustrate that men and women have nearly identical publication patterns. For example, the first graph (Figure 2a) shows that the average number of papers published a year by male and female project grant applicants to the Trust is very similar (an average of 2.5 papers a year).

However, in as much as publishing a paper is an indication of success, some researchers will present their findings in higher-impact journals such as *Nature* and *Science,* and others will submit papers to less well-known titles. The second graph (Figure 2b) illustrates the expected number of citations a paper would receive in the five years following publication, on the basis of the journal in which the papers were published. This indicator demonstrates that women publish in journals of a marginally higher impact than men, although this result is not statistically significant (i.e. $p \geq 0.05$).[d] The final indicator presented in Figure 2c classifies the research type of the journal in which the grant applicants' papers appear. This is on a scale of 1 for clinical observation to 4 for basic research, as indicated by the journal in which the papers are published. Consequently, Figure 2c shows that although women work in slightly more clinical fields than men, both groups are doing very basic work.

[d] Throughout this report the z-test is used to test differences between the bibliometric indices.[6]

Figure 2: Publication patterns for a sample of successful project grant applications



2.2 PROGRAMME GRANTS, 1994–1996

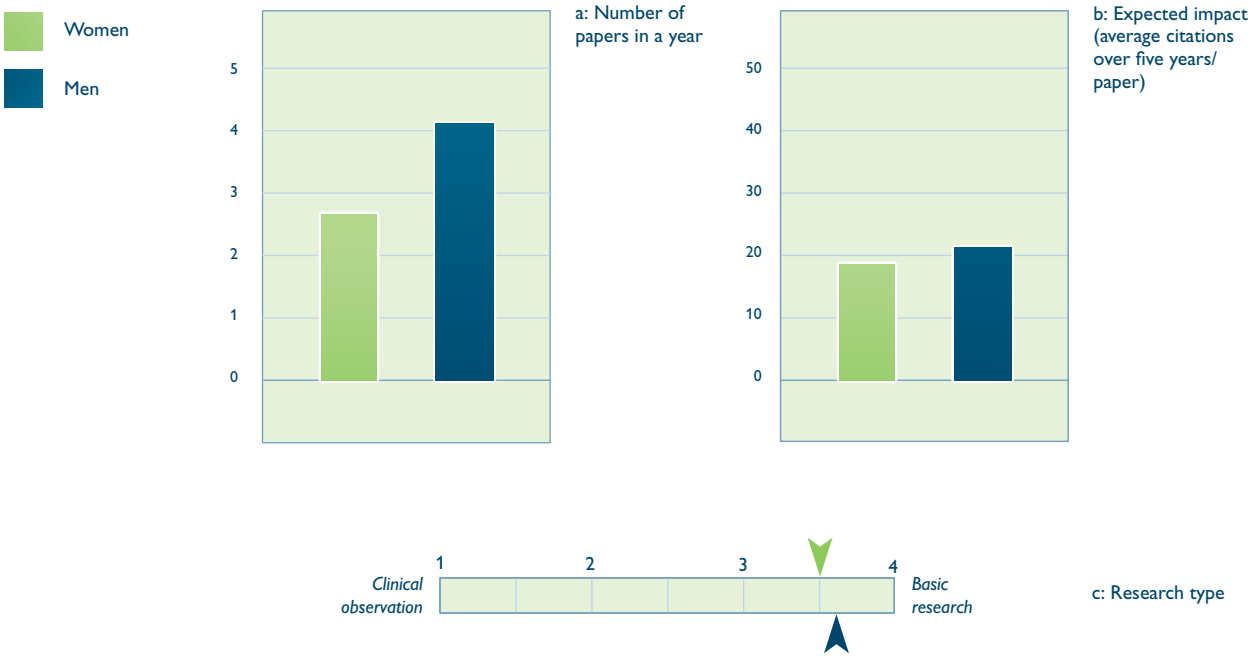
Programme grants are similar to project grants but are usually for larger amounts of money and are awarded for typically over five years in the first instance.[4] In 1995/96, 15 per cent of the Trust's research expenditure was on programme grants, although they only made up 3 per cent of the awards by number that academic year.

Applications for programme grants go through a number of steps before an award is made. In all cases there is a preliminary application stage prior to invitation to submit a full formal grant application, which is then subject to the normal competitive evaluation and peer review. It is the outcomes of formal applications for programme grants accepted between 1994 and 1996 which we have examined in this report. As a result of the preliminary screening process the overall success rate was quite high (50.4 per cent) although, as shown in Table 2, women were more successful than men (62.2 per cent for women versus 47.8 per cent for men). Nevertheless, it is also evident that five times as many men applied to the Trust for programme grants than women.

Table 2 The outcome of full programme grant applications

	Men	Women	Unsexed	Total
Number of applications	115	23	1	139
Number of successful applications	55	15	0	70
Success rate (%)	47.8	62.2	~	50.4

Figure 3: Publication patterns for successful programme grant applications



The publication patterns for successful programme grant applications are summarized in Figure 3 (and are presented in more detail in the Annexes). These results show that successful male programme grant applicants publish significantly (i.e. $p < 0.05$) more papers per year than their female colleagues, but there is no difference in the impact of the journals in which they publish (Figure 3b).

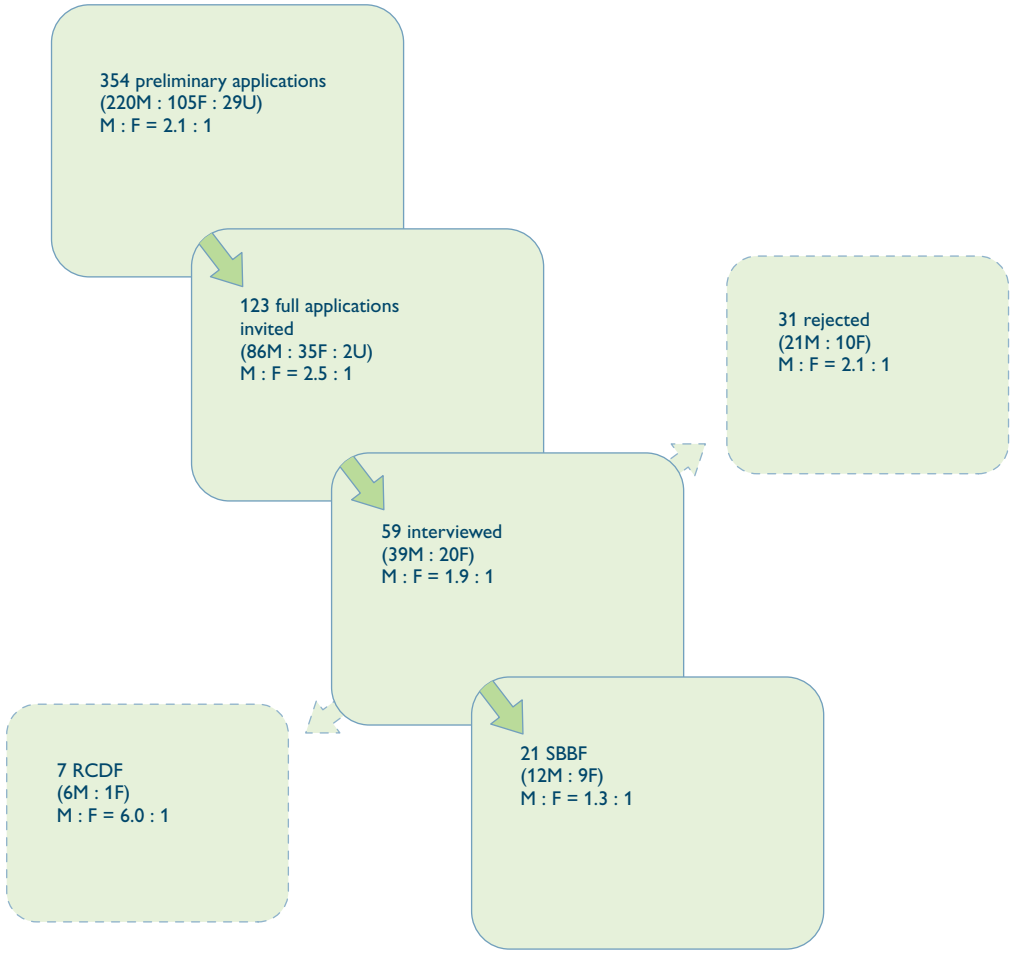
2.3 SENIOR RESEARCH FELLOWSHIPS IN BASIC BIOMEDICAL SCIENCE, 1994/95–1996/97

The Senior Research Fellowships in Basic Biomedical Science (SBBF) is a scheme that enables scientifically qualified workers of exceptional ability to develop their programme of research.[4] Candidates are young investigators who have shown special promise in their initial studies of basic biomedical problems, normally with between five and ten years' research experience from the date of their doctoral degree. All applications made between 1994/95 and 1996/97 for SBBF were examined.[e] Awards are made in an annual competition, commencing with advertisements in the scientific media for preliminary applications. For the three academic years studied, there were 354 preliminary applications (Figure 4). The applications are each assessed by three members of the Basic Science Interest Group (BSIG), which invites candidates to submit a full application. The returned applications (with referees' reports) are then scored by all members of the BSIG and, on the basis of an average score, a short-list for interview is drawn up. Two days of interviews are held each year, and at this stage some candidates may be awarded a Research Career Development Fellowship (RCDF).

Figure 4 summarizes the outcome of applications to the Trust for SBBF. From the 354 preliminary applications, 21 SBBF and seven RCDF were awarded. The overall success rate for SBBF was 5.9 per cent. Female applicants were more successful than males (8.6 per cent versus 5.5 per cent). This is reflected in the declining sex ratio of male to female applicants through the decision-making process (Figure 4). For example, although twice as many men as women initially applied to the Trust for an SBBF, only a third more were awarded full fellowships. Conversely, six times as many men as women were awarded the intermediate RCDF (an award designed to help postdoctoral investigators develop an independent research career in basic biomedical science).[4] There is thus no evidence of discrimination against women in the Trust's decision-making process in awarding SBBF.

[e] A small number of candidates linked to major initiatives are automatically entered at the full application stage. These candidates have been omitted from this analysis.

Figure 4: The outcome of SBBF applications



M = male; F = female; U = unsexed
RCDF = Research Career Development Fellowships
SBBF = Senior Research Fellowships in Basic Biomedical Science

The main reason for analysing the outcome of SBBF was that the applicants are scored by the BSIG in order to determine whom to invite for interview. This allowed us to compare the scores awarded to male and female applicants. The mean score for the interviewees was 7.49 (out of 10), compared to 5.45 for those people who submitted full applications, but were not interviewed. Table 3 presents the mean scores by outcome of interview and sex of applicant. In this table there is no statistically significant (i.e. $p \geq 0.05$) difference between the scores of the male and female candidates.

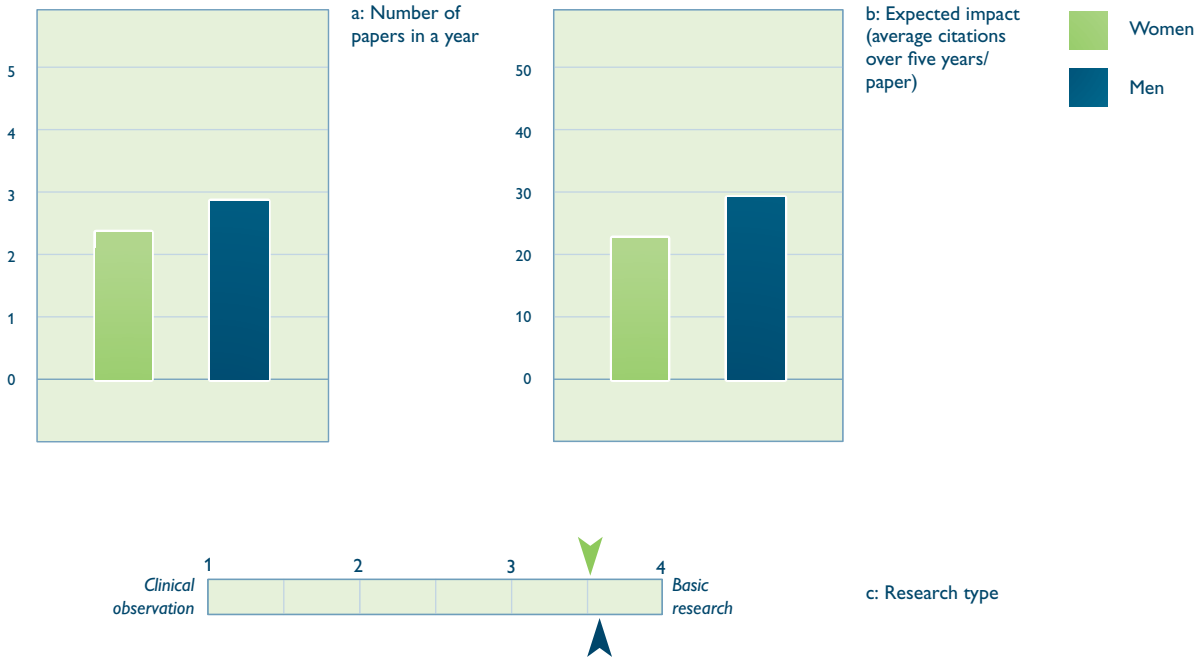
Table 3 SBBF score for interviewed applicants by outcome and sex*

		Rejected	RCDF	SBBF	Total
Men	Mean	7.29	7.31	8.09	7.53
	n	21	6	12	39
	SE	0.12	0.20	0.24	0.11
Women	Mean	7.21	6.90	7.65	7.39
	n	10	1	9	20
	SE	0.19	~	0.21	0.14
Total	Mean	7.27	7.25	7.90	7.49
	n	31	7	21	59
	SE	0.10	0.18	0.15	0.10

*The number of applications is represented by *n* and the standard error by SE.
RCDF = Research Career Development Fellowships
SBBF = Senior Research Fellowships in Basic Biomedical Science

Bibliometric analyses of all applicants who were interviewed for SBBF ($n = 59$; Figure 4) are presented in Figure 5. The only statistically significant (i.e. $p < 0.05$) result is the lower journal impact factor for women, when compared to men (Figure 5b). Therefore, as with programme grants, this analysis suggests that men need to have a better track record than women to be interviewed for an SBBF.

Figure 5: Publication patterns of applicants who were interviewed for SBBF



DISCUSSION 3

3.1 AGE AND SEX CHARACTERISTICS OF THE BIOMEDICAL COMMUNITY

We conclude from the preceding analysis that there is no evidence of discrimination against women in the Trust's decision making on grant applications. The award rates are about the same for women and men in the three schemes analysed, and the publication records of successful applicants are also similar.

It is clear, however, that more men apply to the Trust for research grants than women. There are four times as many male as female applicants for project grants (Table 1), five times as many for programme grants (Table 2), and twice as many for SBBF (Figure 4). One explanation for these differences would be that there are more men working in biomedical science than women in the UK. This is not the case, as is evident in the population pyramid in Figure 6, which describes the characteristics of all biomedical scientists working in UK universities.[f] There were only marginally more male academic biomedical staff than female in 1995/96, and the distribution of staff within the age bands is almost even. In the under-25 age group there were one-and-a-half times more female biomedical academics than male.

Consequently it seems that women do not apply to the Trust for grants in the numbers that would be expected. In 1994 the Trust required applicants to hold tenured university positions; a policy that would have restricted the number of female applicants as, in 1995/96, 1.59 times more men than women held tenured positions in universities.[7] However, current Trust policy permits applications from individuals without tenured positions, as long as they have a sponsor in the same department who does have an established post and can guarantee space, facilities etc. As a result of this change in policy, for every 100 men who are eligible to apply to the Trust there are 78 women that are also eligible (Table 4 and Figure 6). In fact, we found that for every 100 male applicants for project grants there were only 24 females who applied for the same award (Table 4 and Figure 1).

Applicants for programme grants and SBBF will, on the whole, be more senior academics. However, at the senior grades (i.e. senior lecturers, readers and professors) there is an even greater bias towards men; for every 100 eligible men, there are 28 eligible women which, although still more than the 20 observed programme grant applications, is a smaller difference than for project grants (Table 4). Interestingly, for SBBF, for every 100 male candidates there were 48 female candidates. It is difficult to estimate a comparator population for this group, as applications will occur five to ten years after the award of a doctoral degree. However it is likely that the expected number of female applicants for SBBF will be between the numbers expected for project and programme grants (i.e. between 28 and 78 respectively), which is very similar to the observed number (Table 4).

In other words, it seems that women do not apply to the Trust for project or programme grants in the numbers that would be expected, but they do for SBBF. It is difficult to draw conclusive inferences from these results, except to note the SBBF is a career development award, whilst the other two grants support 'project-orientated' research. This may indicate that women prefer fellowship schemes, but such an observation merits further research.

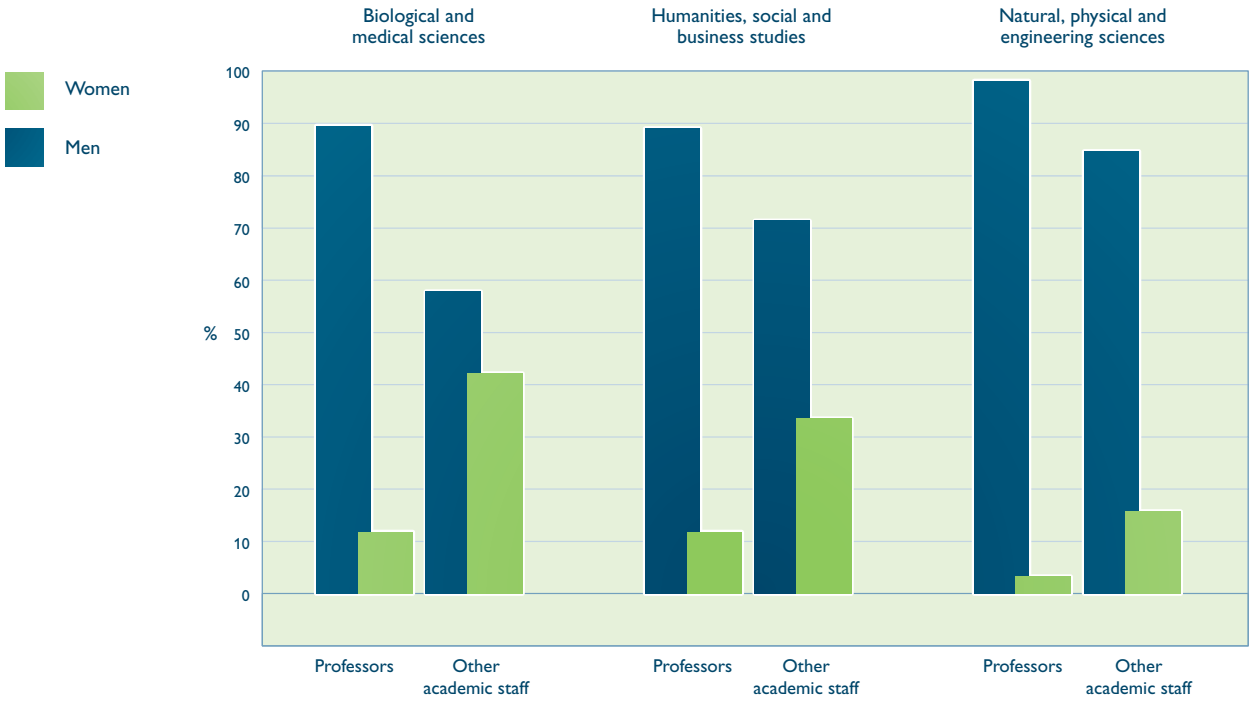
[f] These data were commissioned from the Higher Education Statistics Agency (HESA). Biomedical science is defined as all full-time academic staff working in the following cost centres: clinical medicine, clinical dentistry, veterinary science, anatomy and physiology, nursing and paramedical studies, health and community studies, psychology and behavioural sciences, pharmacy, pharmacology and biosciences.

Table 4 Comparison of observed and expected number of female applicants per 100 male applicants

Scheme	Expected number of female applicants	Observed number of female applicants
Project grants	78	24
Programme grants	28	20
Senior Research Fellowships in Basic Biomedical Science	28–78	48

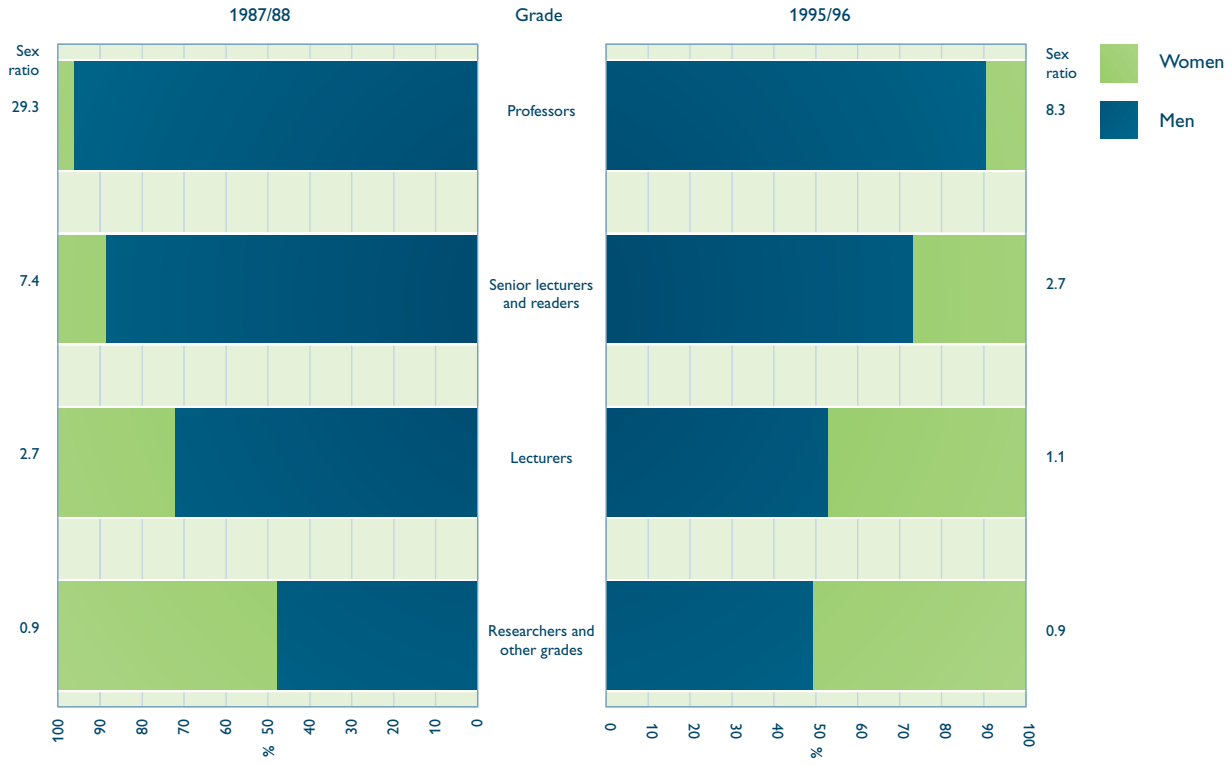
Figure 6: Numbers of biomedical academic staff by age and sex, 1995/96[f]

Figure 7: Proportions of academic staff according to discipline, status and sex, 1995/96[7]



Finally it is worth noting that the dearth of eligible female academics at the senior academic grades is further accentuated at professorial level. For example, within biomedical sciences only one in nine professors is a woman (Figure 7). This may either reflect past employment patterns or be the product of systematic biases against women in academia. Accordingly, only in 20–25 years' time, when today's junior staff are being appointed as professors, will it be possible to examine the extent of discrimination in today's biomedical institutions. This is illustrated in Figure 8, where the proportion of women in biomedical science has changed considerably over the past decade (the overall sex ratio has halved from 2.90 in 1987/88 to 1.28 in 1995/96). As women are now better represented in the non-professorial grades, it can be anticipated that there will be a greater proportion of female professors in the future, unless institutional discrimination is occurring.

Figure 8: Biomedical academic staff by sex and grade, 1987/88, and 1995/96 [7,8]



3.2 CONCLUSION AND POLICY IMPLICATIONS

The study has demonstrated that there is no discrimination against women in the assessment of applications for Wellcome Trust project grants, programme grants or SBBF. Nevertheless, it seems that there are more subtle barriers inhibiting women from applying to the Trust than eligibility. It is significant that not as many women apply to the Trust as would be anticipated, and it is important that the reason(s) for this are examined. We do not know if this is specific to the Trust, or is a pattern experienced by other biomedical (or non-biomedical) research funding agencies. We therefore recommend that funding bodies should, as part of their efforts to ensure equal opportunities, work together to investigate the factors that prevent women from applying for grants in the numbers expected.

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ANNEX 1

BIBLIOMETRIC ANALYSIS

METHODS

The bibliometric analysis of Trust applicants was based on searches of the Science Citation Index (SCI) and Social Sciences Citation Index (SSCI) for the five years preceding the application to the Trust. Searches were conducted on the applicant's name (e.g. SMITH-JB) and bibliographic details of the papers identified were downloaded. Care was taken to include women whose name may have changed following marriage, by referring to the bibliographies sent in by applicants. The data were analysed on an Excel spreadsheet, and for each candidate the papers were filtered by first his/her name and then by their past three academic addresses. Once applicants' papers were identified, a series of different bibliometric indices were calculated:

Count of papers (N)

The total number of papers retrieved from the SCI and SSCI over a five-year period were limited to articles, notes and reviews in accordance with normal bibliometric analysis of substantive research outputs. In Figures 2, 3 and 5 this indicator is presented as the number of papers per year.

Mean research type (RT)

To characterize the research outputs of the applicants, the journals in which the papers were published were classified into four categories (1 = clinical observation; 2 = clinical mix; 3 = clinical investigation; and 4 = basic research). The values of RT for each journal have been allocated on the basis of inspection of the journal by experts and the citation pattern of the papers within it.[9]

Expected impact ($C_{0\text{-}4}$)

Five-year citation records, taken as the average number of citations received by items published in 1990 and cited in journals processed for the SCI/SSCI in the years 1990–94.[10]

Mean journal weighting (W)

The journals in which the papers were published were classified into four categories on the basis of their influence or weighting (W),[11] as determined by their mean $C_{0\text{-}4}$ value. For journals with a $C_{0\text{-}4}$ value ≥ 20, W = 4; for $C_{0\text{-}4} < 20$ but ≥ 10, W = 3; for $C_{0\text{-}4} < 10$ but ≥ 5, W = 2; and, for $C_{0\text{-}4} < 5$, W = 1.

Mean number of authors (A)

The mean number of authors on a paper.

Total influence per author (I)

The sum of the ratio of the journal weighting (W) to the number of authors (A) for each paper published by the applicant.

BIBLIOMETRIC ANALYSIS

RESULTS

Project grants

In order to restrict the workload to a manageable number of searches on the SCI and SSCI, the bibliometric analysis of successful project grant applicants was restricted to a random sample of 25 men and 25 women. The results of this analysis are presented in Table A1, and demonstrate that there were no statistically significant differences (i.e. $p \geq 0.05$) between women and men for the various bibliometric indices.

Programme grants

Bibliometric analyses for all successful applications for programme grants are shown in Table A2, and demonstrate that there are statistically significant sex differences (i.e. $p < 0.05$) in publication records for the number of publications (N), and their influence (I).

SBBF

Bibliometric analyses of all applicants who were interviewed for SBBF ($n = 59$; Figure 4) are presented in Table A3. The only statistically significant result (i.e. $p < 0.05$) is for the expected impact ($C_{0\text{-}4}$) for women, when compared to men.

Table A1 Bibliometric analysis of a sample of successful project grant applications

		N	RT	C_{0-4}	W	A	I
Females	Means	11.20	3.37	13.27	2.44	4.06	8.36
	SE	1.66	0.14	1.75	0.13	0.27	1.16
Males	Means	13.80	3.47	11.75	2.22	3.69	10.54
	SE	1.64	0.11	1.13	0.09	0.25	0.99
Total	Means	12.50	3.42	12.51	2.33	3.88	9.45
	SE	1.65	0.12	1.47	0.11	0.26	1.09

Table A2 Bibliometric analysis for successful programme grant applications[†]

		N	RT	C_{0-4}	W	A	I
Females	Means	13.78*	3.50	18.27	2.73	3.89	11.57*
	SE	2.38	0.16	1.96	0.16	0.33	1.84
Males	Means	20.52	3.67	21.15	2.94	4.18	17.97
	SE	1.94	0.06	1.55	0.06	0.18	1.54
Total	Means	19.38	3.64	20.66	2.90	4.13	16.88
	SE	1.71	0.06	1.34	0.06	0.16	1.37

* Indicates a significant difference between women and men (i.e. $p < 0.05$).
[†]A number of candidates (i.e. five women and 12 men) were omitted from this analysis as their files were not in the registry. This could have a distorting effect on the results presented in this table especially given the low number of women ($n = 15$; Table 2).

Table A3 Bibliometric analysis of applicants who were interviewed for SBBF

		N	RT	C_{0-4}	W	A	I
Females	Means	11.80	3.53	22.72*	2.80	4.18	10.08
	SE	1.12	0.14	2.82	0.13	0.40	1.14
Males	Means	14.31	3.62	29.26	3.09	4.69	12.03
	SE	1.49	0.06	2.36	0.08	0.25	1.33
Total	Means	13.46	3.59	27.04	2.99	4.52	11.37
	SE	1.06	0.06	1.86	0.07	0.22	0.96

* Indicates a significant difference between women and men (i.e. $p < 0.05$).

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