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Gender Bias in Peer Review and Research Funding: An Empirical Analysis of Grant Applications in Pakistan

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ABSTRACT

The current study examined research project submissions by discipline. It also reviewed the peer evaluation reports of these projects. All projects were submitted to a funding agency for grant consideration. There was no gender bias in the selection of the Scrutiny Committee. This committee shortlisted 622 projects out of 1,787 submissions. Female representation in both submitted and shortlisted projects was below 20%. Each shortlisted project was evaluated by two subject experts. They provided detailed comments and a final score. Grade A indicated the highest funding priority, B was medium, and C was the lowest. Each project received two grades, resulting in six possible combinations: AA, BB, CC, AB, BC, and AC. Tests such as Cronbach's alpha and Fleiss' Kappa showed low internal consistency between peer reviewers' grades. This suggests that the scores were based on scientific criteria and not awarded randomly. However, further analysis showed a trend. Male applicants received more favorable scores than females. Female applicants were at a relative disadvantage. The study recommends that peer review alone should not determine funding decisions. A follow-up bulk review, like the one done by the Scrutiny Committee, is necessary. This can help minimize gender bias. Detailed comments and grades from peer reviews can guide the bulk review. They help assess the strengths and weaknesses of each project. This ensures that decisions focus on scientific merit and the project's potential for socio-economic impact through local research. While bulk review may not fully remove gender bias, it reduces the chances of gender-based discrimination. Funding decisions would then be based on well-argued scientific evaluations.

Key Words: Gender Bias, Research Grants, Funding, Peer Review, Bulk Review

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1. Introduction

Peer review is a critical component in the decision-making process of funding agencies and is prone to biases and inefficiencies (Recio-Saucedo et al., 2022). Experts from relevant fields assess research proposals for quality, alignment with national priorities, and relevance to the agency's objectives (Higgins et al., 1990). Research is evaluated with higher emphasis on scientific parameters than on societal relevance (Abma-Schouten et al., 2023) and gender balance is a big phenomenon when it comes to research funding existing in scientific community with varying degrees (Ranga et al., 2012). This paper analyzes a set of research projects submitted to a Pakistani funding agency between 2019 and 2021. The women participation in these projects is less than 20% and exactly similar ration is reported in European study of 11 countries (Hermansson et al., 2021). The evaluation process includes (1) A Scrutiny Committee that shortlists proposals based on scientific merit, commercial viability, researcher credentials, and national priorities and (2) the Peer review of shortlisted projects by subject experts in a single-blind format. Reviewers remain anonymous to both the applicants and each other.

This study explores several key aspects:

- Gender bias in Scrutiny Committee decisions.
- Gender patterns in peer review scoring.
- The influence of research field on gender-based review outcomes.
- Consistency in grading between peer reviewers.
- Appropriate methods for awarding research grants.

Peer review is expected to be objective, free from gender or disciplinary bias. However, it significantly influences how researchers are perceived and their ability to secure grants. This paper specifically investigates the presence of gender and field-based biases in peer review.

Funding of research grants is scarce (Wessely, 1998). Pakistan presents unique challenges due to limited research funding. For example, in 2020–21, the Ministry of Science & Technology had only Rs. 37.91 (approx. $0.10) per capita for scientific initiatives (Finance, 2021). making fair and effective use of funds even more critical.

While journals use peer review to select papers for publication, funding agencies use it to allocate financial resources—making the stakes higher. Gender balance in grant funding is therefore more consequential than in academic publishing (Squazzoni et al., 2025).

Although scientific merit must remain the priority, gender balance ensures equitable inclusion of nearly half the population in national development. Identifying and addressing gender bias in grant review processes is essential (Cruz Castro & Sanz Menéndez, 2020). A standardized, bias-free approach could help female scientists compete on equal footing and contribute more effectively to national progress.

2. Literature Review

There are evidences that gender bias is reflecting in decision making through peer review and the work of women are more likely to be lower graded than those of men, despite high quality of design, quality, and relevance (Budden et al., 2008; Helmer et al., 2017). The gender bias may be implicit due to the general perception of women being less competent and thus less favorable for innovative work through indigenous Research & Development. The Research studies have

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moved a step ahead that the gender bias is not only reflected in rejection rates, instead it is less likely that women are invited as peer reviewers (Lerback & Hanson, 2017; Lerchenmueller & Sorenson, 2018). Such facts lead women towards under representation and lead towards gender bias creating disadvantage for women in scientific endeavors (Squazzoni et al., 2025).
Women are at disadvantage from another point of view citing domestic challenges and childcare which makes it cumbersome for them to serve as active peer reviewer (Nielsen et al., 2017) which perpetuates a stereotype perception that women are less likely to effectively contribute in scientific fields.

Women are considered less likely in collaborative research projects. Male researchers are more likely to be nominated as lead author despite that the woman has significant contribution in the study (Larivière et al., 2013). This scenario limits chances for women to be professionally known.

Single blinded review is more inclined towards high reputation institutions and famous authors than double blinded review (Tomkins et al., 2017) similarly women are less likely to be biased in double blinded peer review than single blinded peer review (Kern-Goldberger et al., 2022). On the contrary, studies also determined the fact that women authors are altogether less in number than men and that double blinded peer review also had no favor increasing probability of women authors' share (Cox & Montgomerie, 2019). Furthermore, the acceptance rate also reduced almost 18%, going from single blinded to double blinded peer review (Ucci et al., 2022).Thus few perceive double blinded as a solution (Rodgers, 2017), few regard it as generating no favor to reduce this bias and designate that a general bias already exist. Another perspective comes across suggesting a triple blind review if that could minimize.

Authors believe triple blinded review can remove biases (Conklin & Singh, 2022; Brodie et al., 2021). The triple blinded peer review is just proposed as it ensures anonymity which in itself is difficult to manage to find peer reviewers being so much anonymous and the solutions proposes are conflict of interest classification and machine learning processes (Jung Jisooand Kim, 2017).

There are available studies that show overall bias towards females (Moss-Racusin et al., 2012) and there are also studies that double blinded peer review shows improvement towards increased representations of females (Budden et al., 2008). There is a section of research that advocates triple blinded review (Brodie et al., 2021; Conklin & Singh, 2022; Jung Jisoo and Kim, 2017). The triple blind study is effective in the context of medical research where anonymity resolves that only result of certain disease or some medicine is important than anybody else and that is prevalent without any critics (Henker et al., 1979; Mills et al., 2006; Nikpour et al., 2014)

The gender bias can even lead towards lack of diversity. The concerns are further being endorsed that the lack of diversity in science can even lead towards biases which will ultimately undermine equity in science (Haffar et al., 2019; Liévano-Latorre et al., 2020). Despite awareness to ensure gender equality in academia the imbalance remains for underrepresented groups (Llorens et al., 2021). Due to many ifs and buts, few even go to extreme and designate the overall peer review system as a flawed system (Smith, 2006). However, its efficacy is determined in multiple studies (Budden et al., 2008; Conklin & Singh, 2022b; Kern-Goldberger et al., 2022; Rodgers, 2017; Snodgrass, 2006) and the argument of a particular study cannot be borrowed.

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There is very thin margin to detect an overall standardized approach towards balanced decisions. Scientific funding may have multiple other merits other than gender and geography which can cause gender bias. At-least we must know that to what extend gender bias is existing so that the best possible measures could be taken to minimize this factor without compromising scientific merits of research studies. Most of these research studies are carried out for Journals, their review process, and ultimate publications (Squazzoni et al., 2025). The context of Peer review and the ultimate decision making for funding agencies is least studied sector where overall research projects could be segregated gender wise and then the peer review reports would be analyzed to determine the overall gender balance. This niché is being addressed in this study.

3. Data Collection

The data were collected in 2019 and in 2021. Two different calls for proposals were announced in national dailies. 1787 research proposals received under the two different calls for proposals. A total of 1030 projects received in 2019-20 and 757 under the second call for proposals in 2020-21. The maximum funding limit for one project was Rs. 20.0 Million ($71,500 US).

The research projects were categorized into 13 major fields of Research & Development, important in the context of Pakistan, like "Agriculture & Food Security", "Information Communication Technology", "Earth, Environment & Climate Change", "Biotechnology, Biochemistry & Molecular Biology", "Water & Soil", "Energy", "Engineering & Manufacturing", "Health Sciences", "Livestock", "Chemistry & Physics", "Other Emerging Areas", "Science Technology Education Mathematics (STEM)" and "Space Sciences".

3. Review Process

A total of 1787 research projects were received. All these projects were screened by a Scrutiny Committee whose role was to investigate the Project Title, its objectives, plan of work, expected outcomes and commercial prospects of the project. Keeping in view above facts, series of fields of study wise scrutiny committee meetings were held which shortlisted 622 research projects out of 1787. These shortlisted projects were sent to subject experts for peer reviewers for full length review. Each project was Peer Reviewed by two subject experts. Each subject expert was paid an amount of Rs. 10,000 for peer review and was given the time for two weeks for peer review. The experts who could not review under the given timeline were changed after the time expiry. All subject experts selected for Peer Review were selected from the relevant fields.

4. Statistical Model:

The total of 622 research projects were peer reviewed, each project by two subject experts. The raters had to give A: Highest Priority for Funding, B: Medium Priority for Funding and C: Lowest Priority for Funding. Each project was reviewed single blinded. The peer reviewer had complete information of the Principal Investigator (P.I.) of the project and the reviewer was anonymous for Principal Investigator (P.I.)

Each project got two grades (A, B or C) from two peer reviewers. Six combinations emerged as AA, BB, CC, AC, BC, and AC. First alphabet from one peer reviewer and the second one is from other. Thus, information emerged under different fields of studies. Each category has gender wise segregation vis-à-vis information of received rating by each peer reviewer.

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So, Crobach's Alpha determined to gauge internal consistency of peer reviewer in awarding grades to the project. Cross tabs analysis of the ratings with Expert-I and Expert-II determines the six combinations of scoring. Fleiss' Kappa was also tested as the peer reviewers were not unique. Further, the percentage of combinations was used to interpret results as the number of female participants were less and male were more in number and thus magnitude could not result in optimum projection to let us have a clear comparison of males versus females scores.

5. Research Findings

The scrutiny committee reviewed 1787 project proposals and sorted out 622 best projects for full length peer review by the relevant subject experts. This study mainly aims to predict the extent of variability in scoring in terms of gender. Following is the total gender balance in the project proposals submitted:

Table 1

Gender Balance in total Projects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	338	18.9	18.9	18.9
	Male	1449	81.1	81.1	100.0
	Total	1787	100.0	100.0	

Table 2

Gender Balance after Shortlisting by Scrutiny Committee

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	115	18.48	18.48	18.48
	Male	507	81.51	81.51	100.0
	Total	1787	100.0	100.0	

Table Out of 1787 research projects received, female to male ration was 18.9 % and 81.1 % respectively, (**Error! Reference source not found.**) However, after review by scrutiny committee where 622 projects were shortlisted out of 1787, female to male ratio was 18.48% and 81.51% respectively. So, the negligible gender difference indicates that there is no gender bias in the committee's decisions as the overall female representation remained constant.

5.1.Cronbach's Alpha

Scale: ALL VARIABLES

Table 1

Cronbach's Alpha Results

		N	%
Cases	Valid	622	34.8
	Excluded[a]	1165	65.2
	Total	1787	100.0

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a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.157	2

Intraclass Correlation Coefficient

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.085[a]	.007	.163	1.187	621	621	.016
Average Measures	.157[c]	.014	.280	1.187	621	621	.016

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type C intraclass correlation coefficients using a consistency definition. The between-measure variance is excluded from the denominator variance.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Table 1 The Cronbach's Alpha coefficient value for two items is .157 for two items which suggests low internal consistency. As two subject experts have to evaluate same research project being anonymous to each other. There is very less homogeneity (15.7%) in the grades awarded by the peer reviewers after thorough evaluation of the research proposals. This test reflects very low chance that the projects will be evaluated with random similar grading by the both experts.

The crosstabs analysis also showed little internal consistency, be it overall, female or male. The cross tabs were obtained with Grades A, B & C awarded by both subject experts I & II.

Table 4

Expert_I * Expert_II * Gender Crosstabulation

Genders			**Expert_II**			**Total**
			A, Highest Priority for Funding	**B, Medium Priority for Funding**	**C, Least Priority for Funding**	
Female	Expert-I	A, Highest Priority for Funding	9	10	9	28
		B, Medium Priority for Funding	9	12	10	31
		C, Least Priority for Funding	15	13	28	56
	Total		**33**	**35**	**47**	**115**

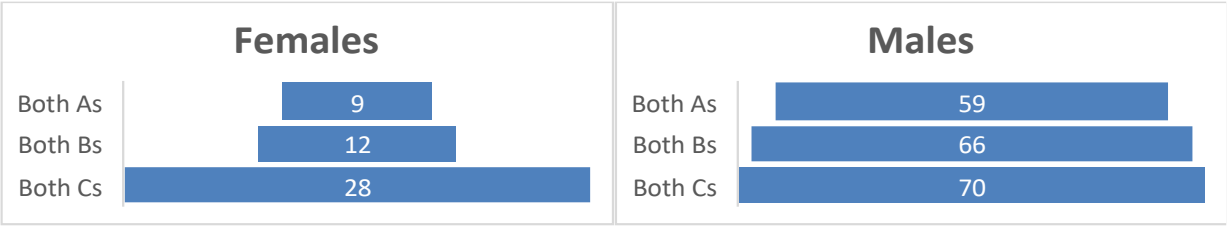
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Male	Expert-I	A, Highest Priority for Funding	59	47	40	146
		B, Medium Priority for Funding	35	66	62	163
		C, Least Priority for Funding	63	65	70	198
	Total		**157**	**178**	**172**	**507**
Total	Expert-I	A, Highest Priority for Funding	68	57	49	174
		B, Medium Priority for Funding	44	78	72	194
		C, Least Priority for Funding	78	78	98	254
	Total		**190**	**213**	**219**	**622**

Error! Reference source not found. Only 68, 78 and 98 projects are those who obtained A, B and C grades respectively by both subject experts I & II out of sample of 622 projects. This reflects interesting picture that trend is increasing in terms of percentage moving from A to C grades i.e., 10.93% (Both As), 12.54% (Both Bs) & 15.76% (Both Cs). Total 244 out of 622 (39.23%) projects have same evaluation by both experts. The similar pattern is also reflected in Cronbach's Alpha coefficient having low internal consistency of 0.157.

Table 5

Tendency of Moving from Both As to Both Cs



Error! Reference source not found. Both A grades reflect high tendency of funding and Cs means lowest. The trend of evaluation of the projects submitted by females has sharp increase moving from Both As to Both Cs i.e., 9 (Both As), 12 (Both Bs) and 28 (Both Cs). However, the situation is different in males where only marginal increase is observed moving from both As to Cs. For males the scores are 59 (Both As), 66 (Both Bs) and 70 (Both Cs). So, the difference is high in females going from both As to both Cs (9 to 28) and it is marginally increasing in males going from both As to both Cs (59 to 70) reflects females at disadvantage in the peer review gradings.

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6. Fleiss' Kappa

The Kohen Kappa being not the relevant test citing that each project was evaluated by two subject experts but the subject experts keep changing for every project. The subject experts were chosen from the relevant field of study of the research project. So, the Fleiss' Kappa was relevant where the raters are not-unique and are randomly selected keeping in view relevance of subject field. The A, B and C grades were given numeric numbers 1, 2 & 3 respectively.

Table 6

Fleiss Kappa Overall Agreement

	Kappa	**Asymptotic**			**Asymptotic 95% Confidence Interval**	
		Standard Error	**z**	**Sig.**	**Lower Bound**	**Upper Bound**
Overall Agreement	.083	.028	2.922	.003	.081	.085

a. Sample data contains 622 effective subjects and 2 raters.

Table 7

Agreement on Individual Categories

Rating Category	Conditional Probability	Kappa	Asymptotic			Asymptotic 95% Confidence Interval	
			Standard Error	z	Sig.	Lower Bound	Upper Bound
1	.293	.115	.040	2.857	.004	.112	.117
2	.327	.083	.040	2.080	.037	.081	.086
3	.380	.055	.040	1.374	.169	.053	.058

a. Sample data contains 622 effective subjects and 2 raters.

Error! Reference source not found. & **Error! Reference source not found.** For three individual categories, there is stark difference and the agreement for highest rating A=1, the value of kappa is just 0.115, for medium rating B=2, the value of kappa is 0.83 and for least rating C=3, the value of kappa is 0.055. As kappa is the degree of agreement, there is very less agreement in higher priority for funding (A=1, kappa=0.115), highest in medium priority for funding (B=2, kappa=0.83) and lowest agreement in least priority for funding (C=1, kappa=0.055). Overall Fleiss' kappa is 0.83 with P value of 0.003 being statistically significant. Citing a thin range of A, B and C grades, the peer reviewer had to choose any one score vis-à-vis kappa value lying in the middle reflects that projects are not least prioritized by the peer reviewers nor the highest prioritized as both A and C have very little agreement of reviewers. However, the agreement seems trending towards B.

With low internal consistency and major agreement trending towards the middle, reflects the projects submitted for funding are not of very high-end quality as rated by peer reviewers. Secondly, the kappa agreement also reflects that no gender bias can be planned as one expert has to rate only one project and that overall agreement is also not lying in A and C categories.

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7. Gender-Wise Grading of Peer Reviewers

The sample contained total 115 projects from female scientists and 507 from male scientists, each got reviewed by two subject experts. Therefore, gender wise percentages were calculated to have a clear picture of the tendency of subject experts to award different grades to the research projects during peer review. The peer review was single blinded where the subject expert had complete detail of the Principal Investigator (P.I.) submitting project for review but the subject expert was not known by the P.I.

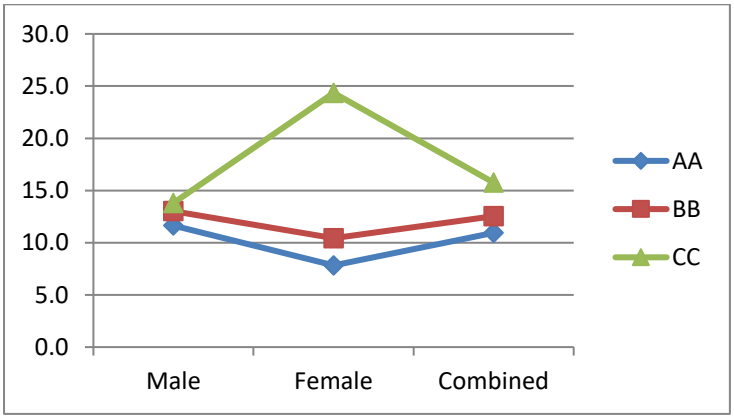


Figure 1 Percentage of projects received A, B & C grades by both Experts

Figure 1 Percentage of projects received A, B & C grades by both Experts, The percentage of projects of females getting CC grades by the subject experts is all the way higher than the average of Male scientists and the combined.

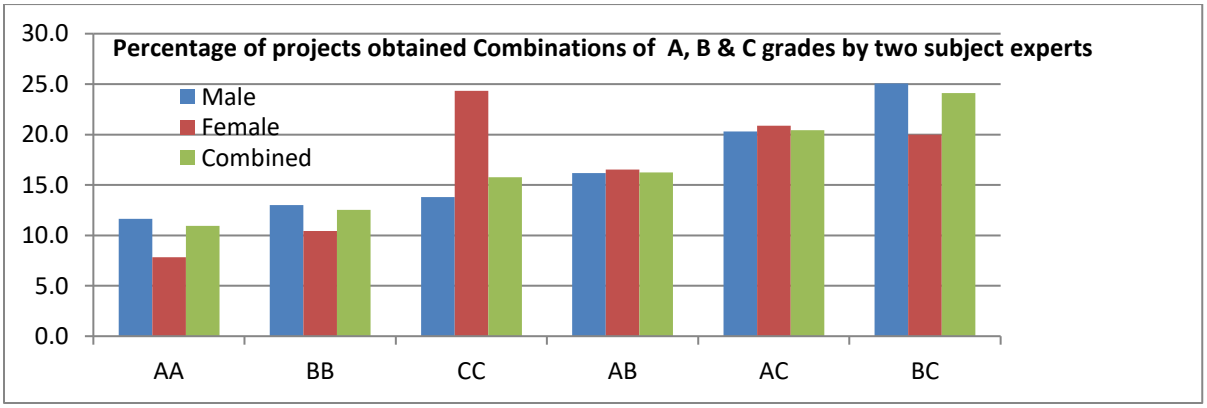


Figure 52 Percentage of projects scored AA reflects both experts awarding A grades…BC means one expert awarding B and the other expert awarding C grade to same project. (A is Higher Priority for Funding, B is Medium Priority for Funding and C is Least Priority for Funding.)

It is once again giving clear reflection that the tendency of giving both CC grades to female scientists is higher as compared to male scientists and even combined average.

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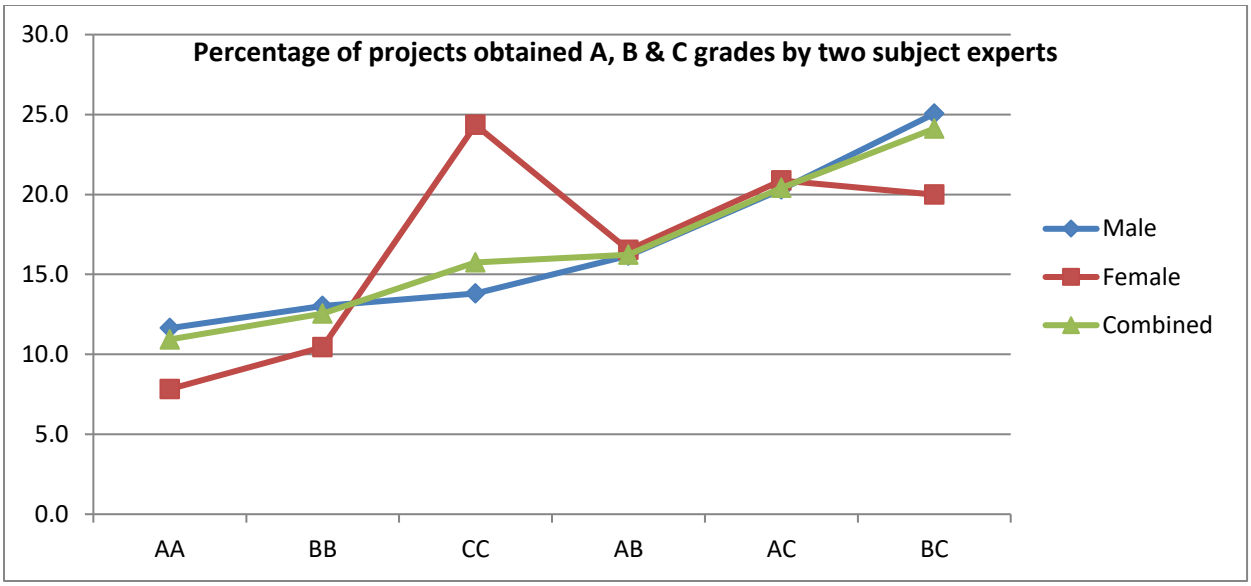
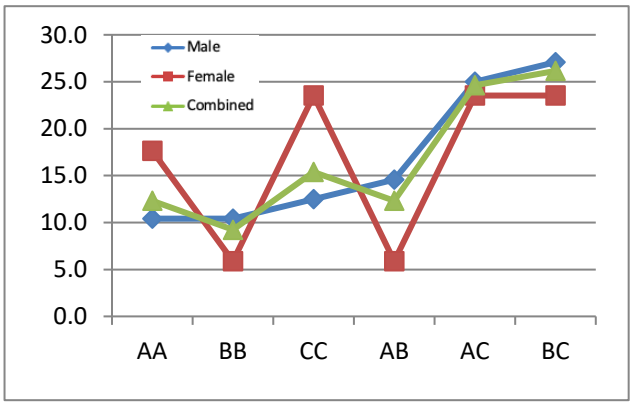


Figure 53 Scores Awarded by Both Experts in all 622 Projects Peer Reviewed by Subject Experts

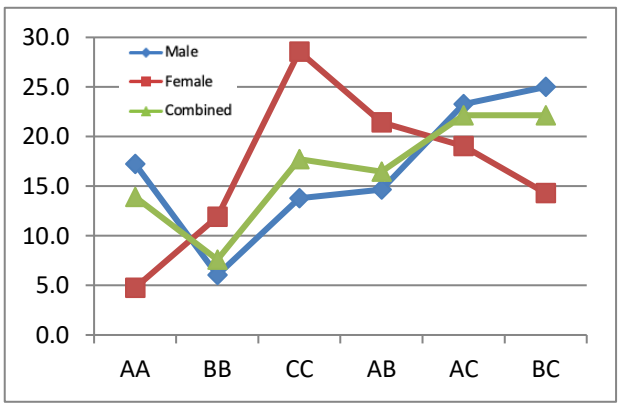
Figure 53 At points of better performance like AA or BB, where the tendency of project to be funded is high, the grades of female scientists are less than males and even less than the combined average. Where the grades reflect least performance, the female value crosses the average and higher in percentage i.e. CC where both experts designate a project as least considerable for funding. So, female gender is least favored.

8. Subject Wise and Gender Wise Grading by Peer Reviewers

The research projects were submitted in different disciplines. The projects were reviewed by two subject experts. Following is the discipline wise grading of peer reviewers reflected in terms of gender:

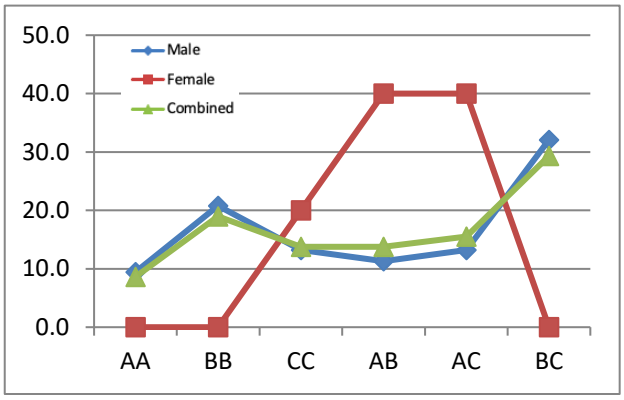


A. Agr. & Food Sci.

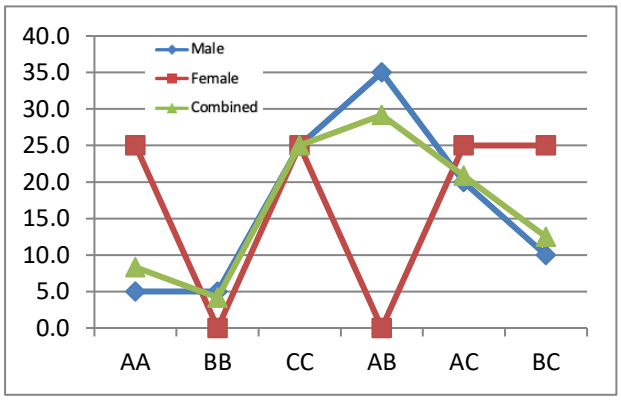


B. Biotech., Biochem. & Mol. Bio.

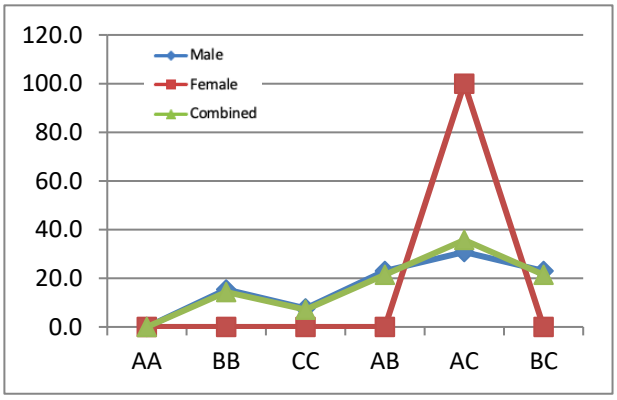
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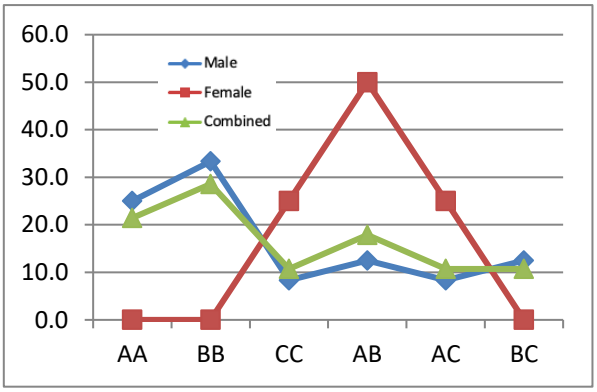
C. ICT



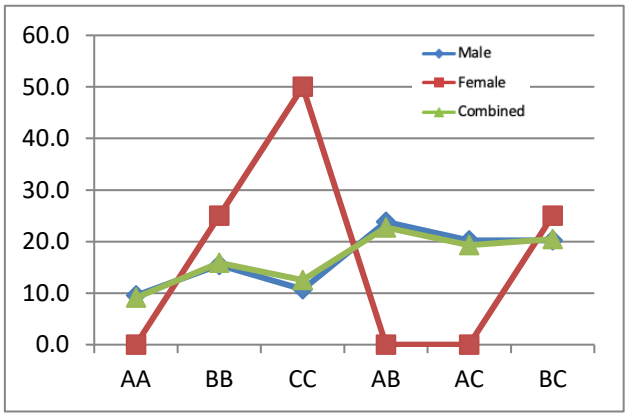
D. Earth. Env. & Climate Ch.



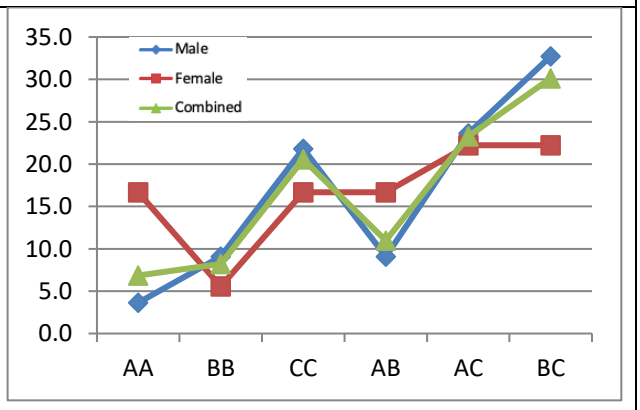
E. Water & Soil



F. Energy



G. Engg. & Manuf.



H. Health Sci.

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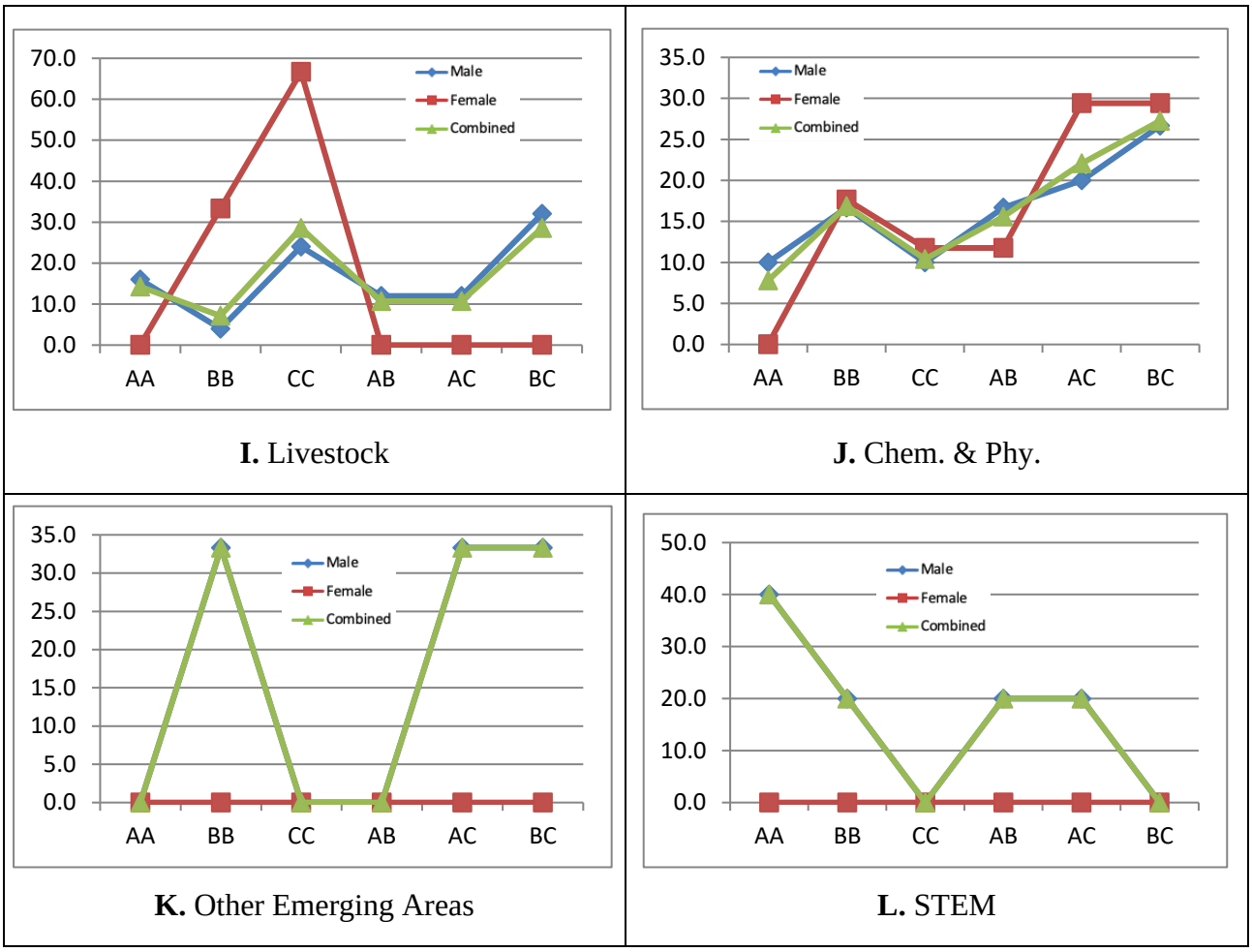


Figure 4 (A-L) Discipline-wise percentage of Peer Review Scoring of Males, Females and Combined

Figure 1(A-L): The pattern reflects scores awarded by peer reviewers in six probable combinations versus the percentage of the number of projects getting those scores' combinations for males, females and combined categories. The impression of female discrimination gets more evident as reflected in Fig. 3 which is combine form of all 12 disciplines from A-L, except Space Science where only one project was submitted from only male member. Grades awarded by all the subjects' experts reflect same pattern that women ratings are at disadvantage than male scientists except in few cases like "Health Sciences" and "Earth, Envr., Climate Change" where females scores are marginally better than males especially at CC levels. In rest of the fields, the female scoring at the levels of CC, is more than males and combined which reflects females at disadvantage.

9. Conclusion

The Cronbach's alpha indicated very low internal consistency, and Fleiss' Kappa revealed weak inter-rater agreement, suggesting a low likelihood of both experts assigning the same grades. Grading was limited to three levels—A (highest), B (moderate), and C (lowest)—offering little room for nuanced interpretation. Graphical analysis of scores by gender (male, female, and

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combined) further highlighted that female scientists consistently received lower peer review grades than their male counterparts.

This finding reinforces the need for double-blinded peer review, where reviewers are unaware of the principal investigator's identity or affiliation. Previous studies have shown reduced bias under this model (Budden et al., 2008; Mulligan et al., 2013; Rodgers, 2017; Snodgrass, 2006; Tomkins et al., 2017), though results have been mixed. Some studies report increased female authorship under double-blind review (Budden et al., 2008), while others found no significant reduction in gender bias (Cox & Montgomerie, 2019; Tomkins et al., 2017). Thus, single-, double-, and triple-blinded reviews each have strengths and limitations.

Controlled studies have also shown that highly rated proposals were sometimes poorly graded, with low inter-rater reliability, challenging the reliability of peer review alone for grant decisions (Mayo et al., 2006). A proposed alternative is the hybrid peer review model, which enables anonymous reviewers to interact with known researchers through a mediated process (Bravo et al., 2019; Lee et al., 2013). This model, in place in Pakistan since the 1970s with support from the U.S. National Science Foundation, is still practiced at the Pakistan Science Foundation (PSF).

At PSF, a technical committee or "bulk review" approach allows multiple experts to collectively evaluate proposals, promoting balanced decisions. In contrast, other agencies like the Higher Education Commission (HEC) rely solely on single-blinded peer reviews. While Pakistan's hybrid system is functional, its true efficacy still needs formal evaluation.

10. Recommendation

Peer review alone—whether single-, double-, or triple-blinded—is insufficient to ensure unbiased funding decisions, as gender bias may still influence outcomes. This study found that while peer review results reflected gender disparity, the Scrutiny Committee's deliberative process-maintained gender balance in the final shortlisting (622 out of 1,787 projects).

Therefore, it is recommended that after peer review, all projects should undergo a consultative review by a panel of experts who examine the reports collectively and reach decisions through mutual discussion. This layered approach may not fully eliminate bias, but it significantly reduces the risk of gender-based discrimination and increases transparency, credibility, and confidence in the funding process within the scientific community.

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FORM FOR BLIND REVIEW (FOREIGN / LOCAL EXPERTS)

Critical Review of Social Sciences and Humanities (CRSSH)
Government Graduate College Township
Higher Education Department
Lahore, Punjab, Pakistan

Reviewer	Dr. Umara Shaheen
Title of the paper	Gender Bias in the Decision Making for Award of Research Grants
Dispatch / e-mail date	June 13, 2025

Reviewer's Comments and Recommendation:
(Please provide comprehensive feedback on the following sections of the Article under Review)

Title & Abstract:

The title is generally clear, but it could be improved to better reflect the focus, structure, and key findings of the study. The title should capture the scope, method, and main finding or argument of the research.

Lines 1–13: The abstract is informative but too dense. Consider breaking it into shorter paragraphs for better readability. Moreover, use academic expressions, such as "instant study", should be replaced with "current study".

Introduction:

Lines 15–63: The introduction includes useful background but is wordy in places. Consider tightening the language for clarity (e.g., lines 35-40).

There are not enough citations/references in this section. Proofread the section to avoid mistakes like "The paper is the gauge…", which can be corrected as "The paper can serve as a gauge."

Literature Review:

Lines 65–147: Comprehensive but includes redundant points. Consider trimming repetitive citations and clarifying contrasting findings.

Methodology:

Lines 149–176: Well described, but some sentences are convoluted. E.g., lines 166–170 could be more concise.

Results:

Lines 178–315: Detailed and well-supported, though interpretation sometimes appears within result descriptions (e.g., lines 289–295).

Discussion:

Lines 317–353: Insightful, though somewhat verbose in places. A clearer distinction between results and interpretation is recommended.

Conclusion/recommendation:

Lines 355–381: Clear and justified, but consider more concise wording (e.g., lines 368–373). **Final comments:** Good article, which can be published with minor revisions.

Reviewers Recommendation: (Please tick the appropriate box)

Sections	Adequate	Minor Changes Required	Major Changes Required	Unacceptable
Title & Abstract		✓		
Introduction		✓		
Literature review	✓			
Methodology	✓			
Results	✓			
Discussion		✓		
Conclusion/recommendation	✓			

Recommendation to Editor (Please mark "X" for appropriate option)
( ) Strongly recommended without any changes (✓) Recommended with minor revisions ( ) Recommended with major revisions ( ) Recommended to decline the submission

Signature (Reviewer) 

FORM FOR BLIND REVIEW (FOREIGN / LOCAL EXPERTS)

Critical Review of Social Sciences and Humanities (CRSSH)
Government Graduate College Township
Higher Education Department
Lahore, Punjab, Pakistan

Reviewer	Dr. Ghulam Ishaq
Title of the paper	Gender Bias in the Decision Making for Award of Research Grants
Dispatch / e-mail date	

Reviewer's Comments and Recommendation:
(Please provide comprehensive feedback on the following sections of the Article under Review)

Title & Abstract:

The title is appropriately specific and immediately conveys the focus of the study. The abstract gives a fair overview of the research, but it is densely written and slightly unfocused in parts. It could benefit from a tighter structure that clearly delineates the background, objectives, methodology, main findings, and recommendations. In its current form, it attempts to condense too much information without precision, which may overwhelm readers unfamiliar with the subject.

Introduction:

The introduction does a commendable job of laying out the context and significance of the issue. However, the text suffers from repetition and lacks thematic coherence in certain areas. The flow between paragraphs is sometimes disjointed, weakening the build-up to the study's core questions. Furthermore, the rationale for the study, though present, is not clearly demarcated. Explicitly highlighting the research gap and questions would improve clarity and reader engagement.

Literature Review:

The literature review is impressively extensive, covering diverse perspectives from empirical studies and theoretical analyses. It successfully positions the study within global discourse. However, the inclusion of multiple contradictory claims (e.g., on the impact of double-blind review) without critical synthesis weakens its analytical depth. The author needs to do more than just cite—there should be a more focused discussion evaluating the strength of previous findings, their methodological robustness, and how they relate to the current study's context.

Methodology:

The study employs sound quantitative techniques, including Cronbach's Alpha and Fleiss' Kappa, to assess inter-rater reliability and consistency. The use of real data from a national funding agency adds originality and authenticity. However, there are some critical limitations that should be addressed:

- The sample is highly imbalanced (507 male-led projects vs. 115 female-led), which affects the power of gender comparison.
- The choice of a single-blind review process raises ethical and methodological concerns—while acknowledged, the analysis doesn't sufficiently explore how this may structurally embed bias.
- Visuals are used extensively, but many are poorly labeled and lack interpretive commentary. Figures should be integrated with the narrative, not just appended.

Results:
The results are comprehensive and supported by robust statistical evidence. Tables and figures illustrate the patterns of grading differences by gender effectively. However, the over-reliance on descriptive statistics limits inferential depth. No regression modeling or hypothesis testing is employed to isolate gender as a causal factor, which would have strengthened claims of bias. Moreover, internal consistency scores are low, but this is discussed primarily as a neutral finding—when, in fact, it raises concerns about the overall reliability of the peer review mechanism itself.

Discussion:
This section appropriately identifies major trends, such as female researchers receiving disproportionately more 'CC' grades. Still, the discussion at times becomes speculative without empirical support. The author makes broad recommendations about systemic reforms without addressing the feasibility, risks, or structural barriers. There's also an under-exploration of intersectional dimensions such as age, institutional prestige, or discipline, which could mediate gender bias. Furthermore, the implications of low reviewer agreement are mentioned but not interrogated in the context of scientific validity.
Conclusion/recommendation:

The conclusion appropriately critiques the overreliance on peer review and recommends a multi-tiered review process. While these suggestions are valuable, they are not fully grounded in a critical appraisal of institutional realities or resource constraints. The advocacy for hybrid or bulk review models is commendable but idealistic in tone. The recommendation section could be strengthened by providing a roadmap for implementation, identifying stakeholders, and proposing evaluative criteria for reform impact.

Final comments:
This is a timely and well-conceptualized study addressing a critical yet under-researched aspect of science policy in Pakistan. The paper's originality lies in its empirical foundation using real-time national data. Nevertheless, the manuscript requires substantial revision in structure, analysis, and theoretical framing to enhance its academic rigor and impact. Strengthening the inferential analysis, refining the argumentation, and addressing the methodological limitations are essential before the paper is considered for publication.

Reviewers Recommendation: (Please tick the appropriate box)

Sections	Adequate	Minor Changes Required	Major Changes Required	Unacceptable
Title & Abstract	X			
Introduction			X	

Literature review		X		
Methodology			X	
Results		X		
Discussion			X	
Conclusion/recommendation		X		

Recommendation to Editor (Please mark "X" for appropriate option)
( ) Strongly recommended without any changes ( ) Recommended with minor revisions **(X) Recommended with major revisions** ( ) Recommended to decline the submission

Signature (Reviewer)

Title: Gender Bias in the Decision Making for Award of Research Grants

1 Abstract

The instant study evaluated the discipline-wise submission of research projects and their peer review reports submitted to a funding agency for the award of grants. Gender bias was not present in the selection of the Scrutiny Committee which shortlisted 622 research projects out of 1787 research projects. Overall female representation in the submitted projects was less than 20%, be it the overall number of projects submitted or the shortlisted projects by the Scrutiny Committee. Each shortlisted project was peer-reviewed by the two subject experts who provided detailed comments and a final score; A was the highest priority for funding, B was considered medium priority for funding and C was the least priority for funding. Each project had two scores and six combinations emerged like AA, BB, CC, AB, BC, and AC. The Cronbach's alpha and Fleiss Kappa both tests showed very low internal consistency amongst grades awarded by the peer reviewers and reaffirmed that grading is done on the professional scientific parameters reducing the element of by-chance grading. Multiple other representations observed that the peer review grades were awarded in such manner where males' scores were at an advantage and females' scores were at a disadvantage. Based on multiple analyses and literature cited, it is recommended that peer review alone is not sufficient to take decisions over final grants. Further, the bulk review as it happened in Scrutiny Committee, would be more appropriate after the peer review to avoid gender bias. The peer review reports' detailed comments and grades can help the bulk review committee to ascertain the pros and cons of the research study and the practical approach of the projects to reach desired results. Although, there is no guarantee that bulk review will eliminate gender bias but it will eliminate any probability of gender discrimination and the decision of funding will be made on the basis of valid arguments on the scientific merits of the project(s).

Keywords: Gender Bias, Research Grants, Funding, Peer Review, Bulk Review

2 Introduction:

The Peer Review is the most important component for funding agencies before considering a project proposal for funding. The experts from relevant field of studies evaluate research projects in terms of quality, suitability to the objectives of the funding agencies and the national priorities. This paper gives

and overview after evaluating a chunk of research projects submitted to a funding agency, in Pakistan, between 2019-21. (i) There is a Scrutiny Committee who reviews all the project proposals to shortlist a few on the basis of scientific merits, commercial aspects, researchers' skills and national priorities. (ii) These shortlisted projects are then single blinded Peer-Reviewed by the subject experts of the relevant fields of research projects. (iii) Both Peer Reviewers are anonymous to each other as well for the researchers.

This paper is the gauge of multiple factors in evaluation of research projects by the subject experts i.e., (i) Prevalence of gender bias in the decisions of Scrutiny Committee(s).(ii) How gender balance is reflected in Peer Review scoring? (iii) How the gender is reflected in Peer Review Scores vis-à-vis field of research project? (iv) Association in grading of Peer Reviewers (v) Appropriate approach for award of research grants.

The peer review is supposed to be balanced irrespective of any bias, be it gender or the particular field of study. The peer review has a prominent role in shaping the perception of the contribution of the researcher and in turn his or her success in harnessing grants. Specifically, this paper will evaluate the gender bias in peer review and bias towards fields of study. Although, in Pakistan where this study is conducted has different dynamics in terms of availability of funding opportunities. The calculations of the budget document of Finance Division of Pakistan revealed that in 2020-21, Ministry of Science & Technology Pakistan has only Rs. 37.91 (0.1$) per capita available funds for its scientific initiatives (Finance, 2021). Today, its around Rs. 300/$. The importance of funding out of scarce resources is of utmost importance.

The Peer review is carried out by the journals for selection of research papers for their publication on the basis of review reports. The same approach is adopted by the funding agencies to select best projects for funding. The publication of a research paper has limited scope as compared to funding agencies as in later cases the concerned study is to be funded through grants. Thus, the gender balance in funding agencies is of more importance than journals.

The more important function for award of grant is the suitability to certain objectives of the Call for Proposals. The scientific merit is more important than having any focus on any gender but the fact cannot be denied that gender balance brings along at par almost half of the population for the development of nations. So, this study to gauge any gender bias becomes very important and its

outcome can be fruitful to help bring female scientists at par with popular male section of societies, if we are able to adopt a standardized approach which could eliminate discriminated decision making.

3 Literature Review:

The gender bias reflects in peer review and the work of women are more likely to be lower graded than those of men, despite high level of design, quality and relevance (Budden et al., 2008; Helmer et al., 2017). The gender bias may be implicit due to the general perception of women being less competent and thus less favorable for innovative work through indigenous Research & Development. The Research studies have moved a step ahead that the gender bias is not only reflected in rejection rates, instead it is less likely that women are invited as peer reviewers (Lerback & Hanson, 2017; Lerchenmueller & Sorenson, 2018). Such facts lead women towards under representation and leads towards gender bias creating disadvantage for women in scientific endeavors.

Women are at disadvantage from another point of view citing domestic challenges and childcare which makes it cumbersome for them to serve as active peer reviewer (Nielsen et al., 2017) which perpetuates a stereotype perception that women is less likely to effectively contribute in scientific fields.

Women are considered less likely in collaborative research projects. Male researchers are more likely to be nominated as lead author despite that the woman has significant contribution in the study (Larivière et al., 2013). This scenario limits chances for women to be professionally known.

Single blinded review is more inclined towards high reputation institutions and famous authors than double blinded review (Tomkins et al., 2017) similarly women are less likely to be biased in double blinded peer review than single blinded peer review (Kern-Goldberger et al., 2022). On the contrary, studies also determined the fact that women authors are altogether less in number than men and that double blinded peer review also had no favor increasing probability of women authors' share (Cox & Montgomerie, 2019). Furthermore, the acceptance rate also reduced almost 18%, going from single blinded to double blinded peer review (Ucci et al., 2022).Thus few perceive double blinded as a solution (Rodgers, 2017), few regard it as generating no favor to reduce this bias and designate that a general bias already exist. Another perspective comes across suggesting a triple blind review if that could minimize. Authors believe triple blinded review can remove biases (Conklin & Singh, 2022; Brodie et al., 2021). The triple blinded peer review is just proposed as it ensures anonymity which in itself is difficult

to manage to find peer reviewers being so much anonymous and the solutions proposes are conflict of interest classification and machine learning processes (Jung Jisooand Kim, 2017). There are available studies that show overall bias towards females (Moss-Racusin et al., 2012) and there are also studies that double blinded peer review shows improvement towards increased representations of females (Budden et al., 2008). There is a section of research that advocates triple blinded review (Brodie et al., 2021; Conklin & Singh, 2022; Jung Jisoo and Kim, 2017). The common point is beyond understanding that how come triple blind can reduce gender bias when no one is known to anyone in the study. The triple blind study is effective in the context of medical research where anonymity resolves that only result of certain disease or some medicine is important than anybody else and that is prevalent without any critics (Henker et al., 1979; Mills et al., 2006; Nikpour et al., 2014)

The gender bias can even lead towards lack of diversity. The concerns are further being endorsed that the lack of diversity in science can even lead towards biases which will ultimately undermine equity in science (Haffar et al., 2019; Liévano-Latorre et al., 2020). Despite awareness to ensure gender equality in academia the imbalance still remains for underrepresented groups (Llorens et al., 2021). Due to many ifs and buts, few even go to extreme and designate the overall peer review system as a flawed system (Smith, 2006). However, its efficacy is determined in multiple studies (Budden et al., 2008; Conklin & Singh, 2022b; Kern-Goldberger et al., 2022; Rodgers, 2017; Snodgrass, 2006)and the argument of a particular study can not be borrowed.

There is very thin margin to detect an overall standardized approach towards balanced decisions. Scientific funding may have multiple other merits other than gender and geography which can cause gender bias. At-least we must know that to what extend gender bias is existing so that the best possible measures could be taken to minimize this factor without compromising scientific merits of research studies. Most of these research studies are carried out for Journals, their review process and ultimate publications. The context of Peer review and the ultimate decision making for funding agencies is least studied sector where overall research projects could be segregated gender wise and then the peer review reports would be analysed to determine the overall gender balance. This niché is being addressed in this study.

4 Data Collection:

The data is collected in 2019 and in 2021. Two different calls for proposals were announced in national dailies. 1787 research proposals received under the two different calls for proposals. A total of 1030 projects received in 2019-20 and 757 under the second call for proposals in 2020-21. The maximum funding limit for one project was Rs. 20.0 Million.

The research projects were categorized into 13 major fields of Research & Development, important in the context of Pakistan, like "Agriculture & Food Security", "Information Communication Technology", "Earth, Environment & Climate Change", "Biotechnology, Biochemistry & Molecular Biology", "Water & Soil", "Energy", "Engineering & Manufacturing", "Health Sciences", "Livestock", "Chemistry & Physics", "Other Emerging Areas", "Science Technology Education Mathematics (STEM)" and "Space Sciences".

5 Review Process

A total of 1787 research projects were received. All these projects were screened by a Scrutiny Committee whose role was to look into the Project Title, its objectives, plan of work, expected outcomes and commercial prospects of the project. Keeping in view above facts, series of fields of study wise scrutiny committee meetings were held which shortlisted 622 research projects out of 1787. These shortlisted projects were sent to subject experts for peer reviewers for full length review. Each project was Peer Reviewed by two subject experts. Each subject expert was paid an amount of Rs. 10,000 for peer review and was given the time for two weeks for peer review. The experts who couldn't review under the given timeline were changed after the time expiry. All subject experts selected for Peer Review were selected from the relevant fields.

6 Statistical Model:

The total of 622 research projects were peer reviewed, each project by two subject experts. The raters had to give A: Highest Priority for Funding, B: Medium Priority for Funding and C: Lowest Priority for Funding. Each project was reviewed single blinded. The peer reviewer had complete information of the Principal Investigator (P.I.) of the project and the reviewer was anonymous for Principal Investigator (P.I.)

Each project got two grades (A, B or C) from two peer reviewers. Six combinations emerged as AA, BB, CC, AC, BC and AC. First alphabet from one peer reviewer and the second one is from other. Thus, information emerged under different fields of studies. Each category has gender wise segregation vis-à-vis information of received rating by each peer reviewer. So,

Crobach's Alpha determined to guage internal consistency of peer reviewer in awarding grades to the project. Cross tabs analysis of the ratings with Expert-I and Expert-II determines the six combinations of scoring. Fleiss' Kappa was also tested as the peer reviewers weren't unique. Further, the percentage of combinations were used to interpret results as the number of female participants were less as compared to males and thus magnitude couldn't result in optimum projection to let us have a clear comparison of males versus females scores.

7 Research Findings

The scrutiny committee reviewed 1787 project proposals and sorted out 622 best projects for full length peer review by the relevant subject experts. This study mainly aims to predict the extent of variability in scoring in terms of gender. Following is the total gender balance in the project proposals submitted:

Gender Balance in 1787 Total Projects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	338	18.9	18.9	18.9
	Male	1449	81.1	81.1	100.0
	Total	1787	100.0	100.0	

Table 7.1 Gender Ratio

Gender in 622 Projects Shortlisted by Scrutiny Committees

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	115	18.48	18.48	18.48
	Male	507	81.51	81.51	100.0
	Total	1787	100.0	100.0	

Table 7.2 Gender Balance after Shortlisting by Scrutiny Committee

Table 7.1 The gender balance of total 1787 research projects funded was 18.9% and 81.1% for females and males respectively. Whereas, after shortlisting by the scrutiny committee which consisted of experts

from relevant fields and commercialization experts, (Table 7.2) 622 research projects were shortlisted wherein this ratio is found to be 18.48% and 81.51% for females and males respectively.

The difference of gender is almost negligible in the decision of scrutiny committees. The overall women representation ration re-emerged in the shortlisted projects by the scrutiny committee(s) which clearly reflected that the gender bias was not present in the decisions of Scrutiny Committee.

7.1 Cronbach's Alpha:

Scale: ALL VARIABLES

Table 7.3 Cronbach's Alpha Results

Case Processing Summary

		N	%
Cases	Valid	622	34.8
	Excluded[a]	1165	65.2
	Total	1787	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.157	2

Intraclass Correlation Coefficient

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.085[a]	.007	.163	1.187	621	621	.016
Average Measures	.157[c]	.014	.280	1.187	621	621	.016

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type C intraclass correlation coefficients using a consistency definition. The between-measure variance is excluded from the denominator variance.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Table 7.3 The Cronbach's Alpha coefficient value for two items is .157 for two items which suggests low internal consistency. As two subject experts have to evaluate same research project being anonymous

to each other. There is very less homogeneity (15.7%) in the grades awarded by the peer reviewers after thorough evaluation of the research proposals. This test reflects very low chance that the projects will be evaluated with random similar grading by the both experts.

The crosstabs analysis also showed little internal consistency, be it overall, female or male. The cross tabs were obtained with Grades A, B & C awarded by both subject experts I & II.

Expert_I * Expert_II * Gender Crosstabulation

Genders			Expert_II			Total
			A, Highest Priority for Funding	B, Medium Priority for Funding	C, Least Priority for Funding	
Female	Expert_I	A, Highest Priority for Funding	9	10	9	28
		B, Medium Priority for Funding	9	12	10	31
		C, Least Priority for Funding	15	13	28	56
	Total		**33**	**35**	**47**	**115**
Male	Expert_I	A, Highest Priority for Funding	59	47	40	146
		B, Medium Priority for Funding	35	66	62	163
		C, Least Priority for Funding	63	65	70	198
	Total		**157**	**178**	**172**	**507**
Total	Expert_I	A, Highest Priority for Funding	68	57	49	174
		B, Medium Priority for Funding	44	78	72	194
		C, Least Priority for Funding	78	78	98	254
	Total		**190**	**213**	**219**	**622**

Table 7.4 Gender Cross Tabulation with Peer Review Grading

Table 7.4 Only 68, 78 and 98 projects are those who obtained A, B and C grades respectively by both

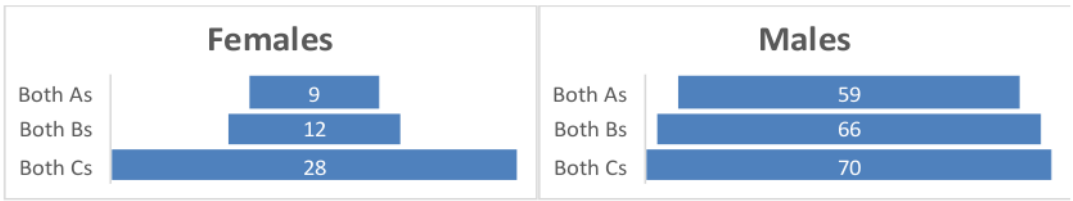


Table 7.5 Tendency of Moving from Both As to Both Cs

subject experts I & II out of sample of 622 projects. This reflects interesting picture that trend is increasing in terms of percentage moving from A to C grades i.e., 10.93% (Both As), 12.54% (Both Bs) & 15.76% (Both Cs). Total 244 out of 622 (39.23%) projects have same evaluation by both experts. The similar pattern is also reflected in Cronbach's Alpha coefficient having low internal consistency of 0.157.

Table 7.5 Both A grades reflect high tendency of funding and Cs means lowest. The trend of evaluation of the projects submitted by females has sharp increase moving from Both As to Both Cs i.e., 9 (Both As), 12 (Both Bs) and 28 (Both Cs). However, the situation is different in males where only marginal increase is observed moving from both As to Cs. For males the scores are 59 (Both As), 66 (Both Bs) and 70 (Both Cs). So, the difference is high in females going from both As to both Cs (9 to 28) and it is marginally increasing in males going from both As to both Cs (59 to 70) reflects females at disadvantage in the peer review gradings.

7.2 Fleiss' Kappa:

The Kohen Kappa being not the relevant test citing that each project was evaluated by two subject experts but the subject experts keep changing for every project. The subject experts were chosen from the relevant field of study of the research project. So, the Fleiss' Kappa was relevant where the raters are not-unique and are randomly selected keeping in view relevance of subject field. The A, B and C grades were given numeric numbers 1, 2 & 3 respectively.

Table 7.6 Fleiss Kappa Overall Agreement[a]

	Kappa	Asymptotic			Asymptotic 95% Confidence Interval	
		Standard Error	z	Sig.	Lower Bound	Upper Bound
Overall Agreement	.083	.028	2.922	.003	.081	.085

a. Sample data contains 622 effective subjects and 2 raters.

Table 7.7 Agreement on Individual Categories

Rating Category	Conditional Probability	Kappa	Asymptotic			Asymptotic 95% Confidence Interval	
			Standard Error	z	Sig.	Lower Bound	Upper Bound
1	.293	.115	.040	2.857	.004	.112	.117
2	.327	.083	.040	2.080	.037	.081	.086
3	.380	.055	.040	1.374	.169	.053	.058

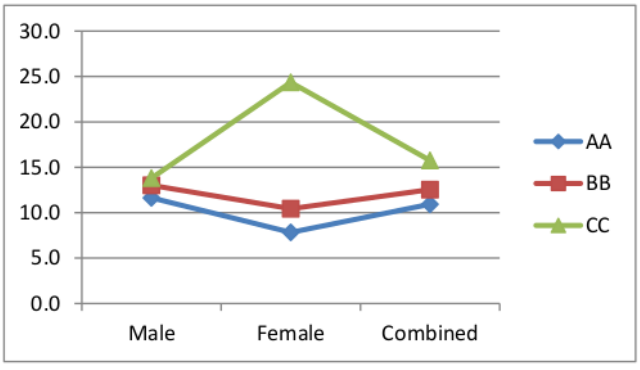
a. Sample data contains 622 effective subjects and 2 raters.

Table 7.6 & **Table 7.7** For three individual categories, there is stark difference and the agreement for highest rating A=1, the value of kappa is just 0.115, for medium rating B=2, the value of kappa is 0.83 and for least rating C=3, the value of kappa is 0.055. As kappa is the degree of agreement, there is very less agreement in higher priority for funding (A=1, kappa=0.115), highest in medium priority for funding (B=2, kappa=0.83) and lowest agreement in least priority for funding (C=1, kappa=0.055). Overall Fleiss' kappa is 0.83 with P value of 0.003 being statistically significant. Citing a thin range of A, B and C grades, the peer reviewer had to choose any one score vis-à-vis kappa value lying in the middle reflects that projects are not least prioritized by the peer reviewers nor the highest prioritized as both A and C have very little agreement of reviewers. However, the agreement seems trending towards B.

With low internal consistency and major agreement trending towards the middle, reflects the projects submitted for funding are not of very high-end quality as rated by peer reviewers. Secondly, the kappa agreement also reflects that no gender bias can be planned as one expert has to rate only one project and that overall agreement is also not lying in A and C categories.

7.3 Gender-Wise Grading of Peer Reviewers

The sample contained total 115 projects from female scientists and 507 from male scientists, each got reviewed by two subject experts. Therefore, gender wise percentages were calculated to have a clear picture of the tendency of subject experts to award different grades to the research projects during peer review. The peer review was single blinded where the subject expert had complete detail of the Principal Investigator (P.I.) submitting project for review but the subject expert was not known by the P.I.



10

Figure 7.1 Percentage of projects received A, B & C grades by both Experts

10

Figure 7.1 Percentage of projects received A, B & C grades by both Experts, The percentage of projects of females getting CC grades by the subject experts is all the way higher than the average of Male scientists and the combined.

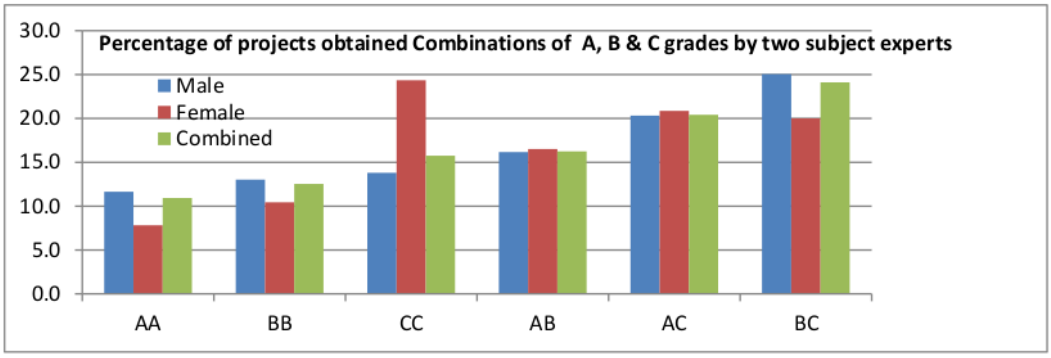


Figure 7.2 Percentage of projects scored AA reflects both experts awarding A grades…BC means one expert awarding B and the other expert awarding C grade to same project. (A is Higher Priority for Funding, B is Medium Priority for Funding and C is Least Priority for Funding.)

It is once again giving clear reflection that the tendency of giving both CC grades to female scientists is higher as compared to male scientists and even combined average.

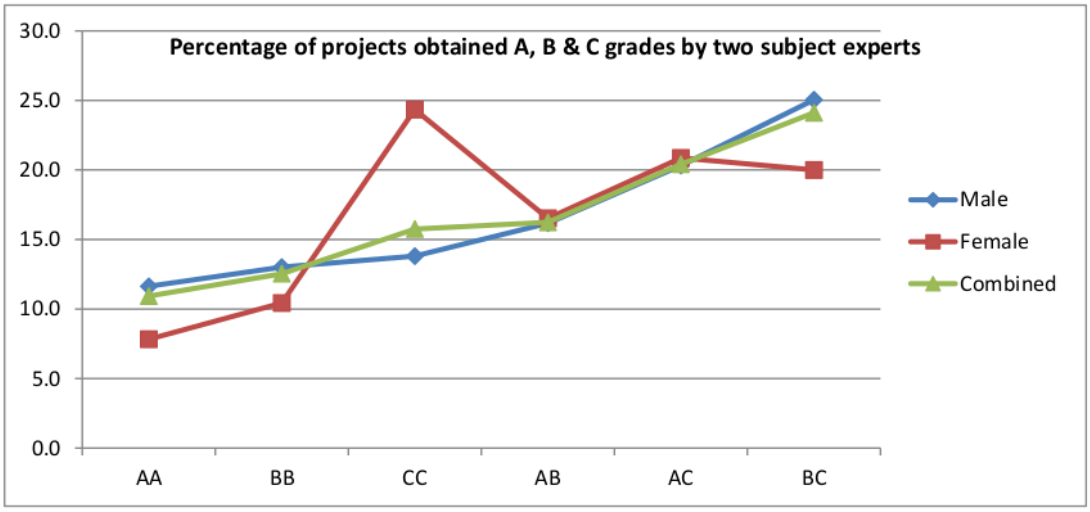


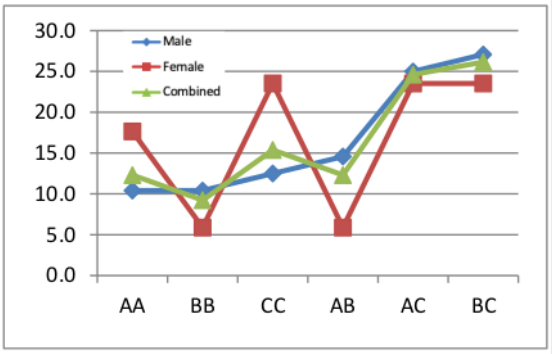
Figure 7.3 Scores Awarded by Both Experts in all 622 Projects Peer Reviewed by Subject Experts

Figure 7.3: At points of better performance like AA or BB, where the tendency of project to be funded is high, the grades of female scientists are less than males and even less than the combined average.

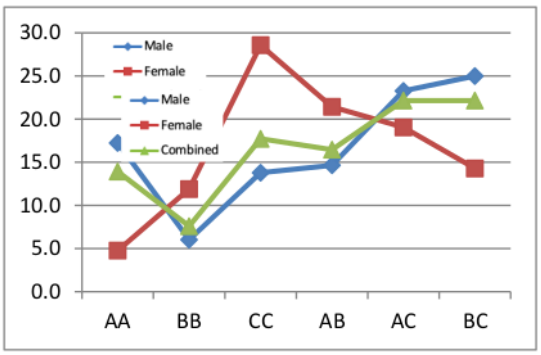
Where the grades reflect least performance, the female value crosses the average and higher in percentage i.e. CC where both experts designate a project as least considerable for funding. So, female gender is least favored.

7.3.1 Subject Wise and Gender Wise Grading by Peer Reviewers

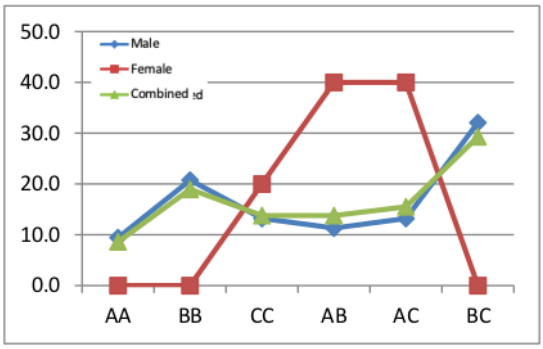
The research projects were submitted in different disciplines. The projects were reviewed by two subject experts. Following is the discipline wise grading of peer reviewers reflected in terms of gender:



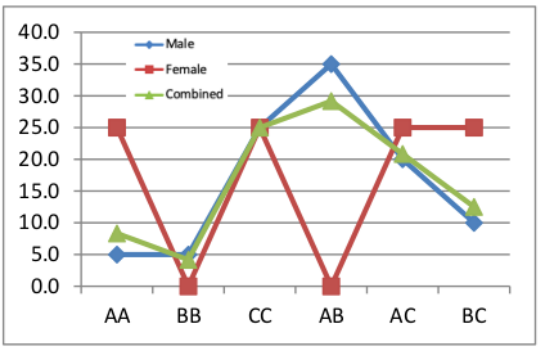
A. Agr. & Food Sci.



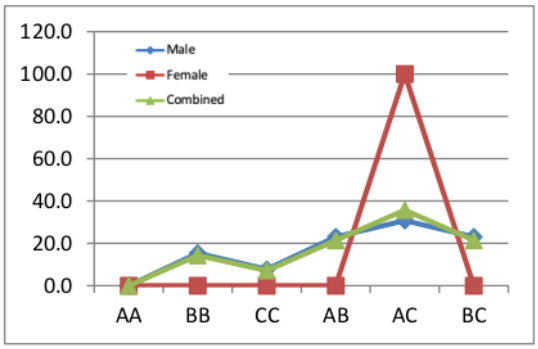
B. Biotech., Biochem. & Mol. Bio.



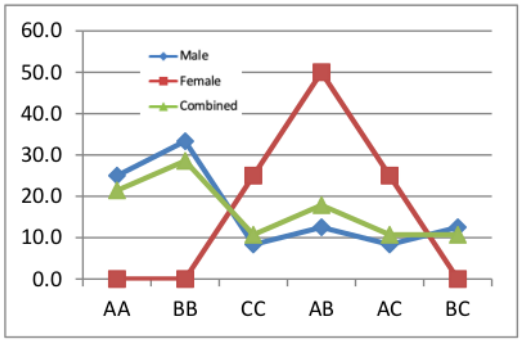
C. ICT



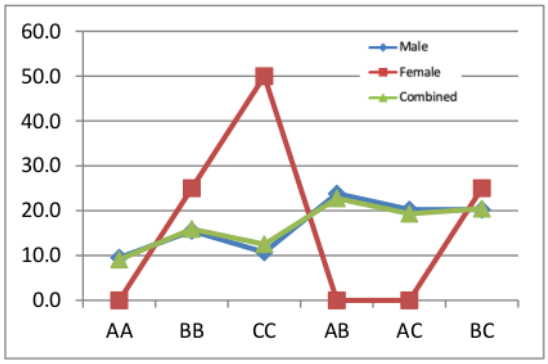
D. Earth. Env. & Climate Ch.



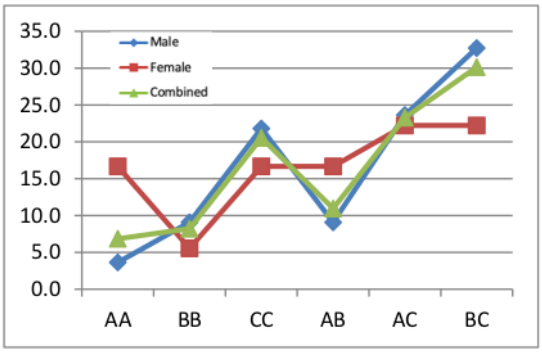
E. Water & Soil



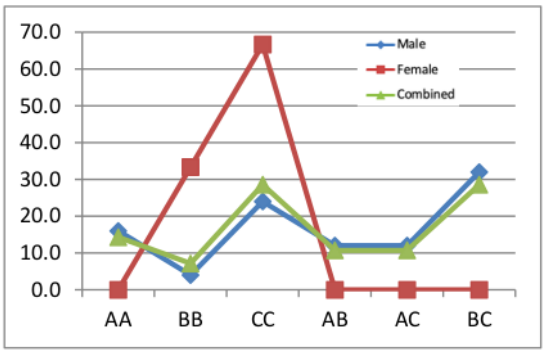
F. Energy



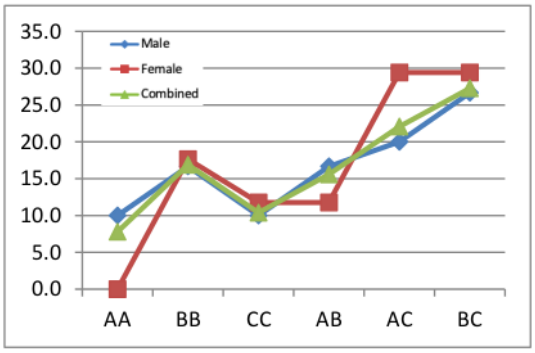
G. Engg. & Manuf.



H. Health Sci.



I. Livestock



J. Chem. & Phy.

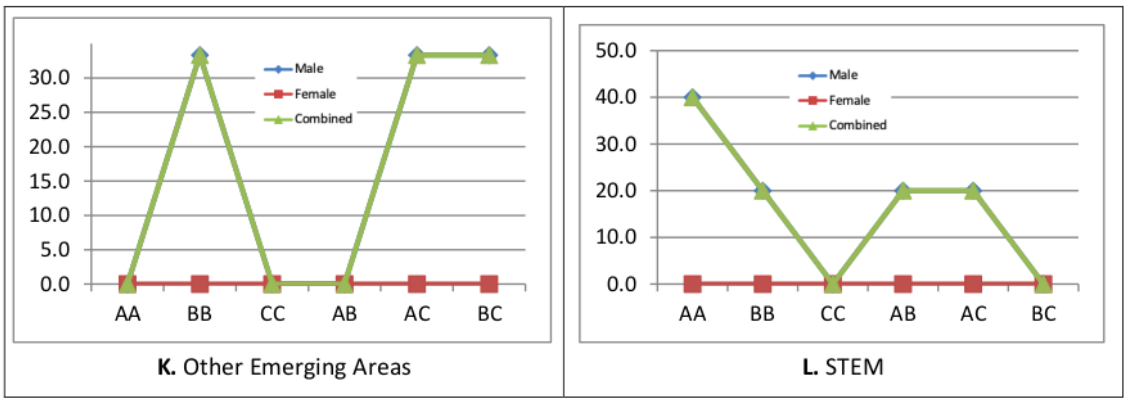


Figure 7.4 (A-L) Discipline-wise percentage of Peer Review Scoring of Males, Females and Combined

Figure 7.1(A-L): The pattern reflects scores awarded by peer reviewers in six probable combinations versus the percentage of the number of projects getting those scores' combinations for males, females and combined categories. The impression of female discrimination gets more evident as reflected in Fig. 3.5 which is combine form of all 12 disciplines from A-L, except Space Science where only one project was submitted from only male member. Grades awarded by all the subjects' experts reflect same pattern that women ratings are at disadvantage than male scientists except in few cases like "Health Sciences" and "Earth, Envr., Climate Change" where females scores are marginally better than males especially at CC levels. In rest of the fields, the female scoring at the levels of CC, is more than males and combined which reflects females at disadvantage.

8 Conclusion:

The Cronbach's reflected very low internal consistency and Fleiss Kappa showed very less probability that both experts will award same grades. The grading range was also limited like Highest was A, Medium was B and Least preferred was C. So, the results of these tests giving very low margin of interpretation which is strengthened by the actual graphs of the raters' evaluation for Males, Females and then Combined to reflect that to what extent any gender is at disadvantage. The result showed female scientists are at disadvantage in terms of grading by the Peer Reviewers. The one conclusion is supported again in this research that the female score lower in peer review grading as compared to males. So, the proposal of double blinded peer review is reinforced where the name of principle investigator, institutional affiliation should be anonymous for peer reviewer. Former studies also proved significant reduction in bias in double-blinded peer review (Budden et al., 2008; Mulligan et al., 2013; Rodgers, 2017; Snodgrass, 2006; Tomkins et al., 2017). However, the double-blinded peer review also

showed deviation from standard expectations that somewhere, it happened opposite that female first authored number of papers increased (Budden et al., 2008) while few had no significant reduction in gender bias due to double blinded Peer Review (Cox & Montgomerie, 2019; Tomkins et al., 2017). So, single blinded, double blinded and triple blinded have their own efficacies and limitations. The controlled studies of peer reivewers reflected very high rated projects were not awarded good grading and even raters own agreement was found poor which negated the approach to depend upon peer reviewers for award of grants(Mayo et al., 2006). A midway approach to minimize negative impacts are proposed by researchers like hybrid-peer-review system having open discussions between researchers and the peer reviewers wherein the name of peer reviewer remains anonymous while the name of researcher remains known to the peer reviewer(Bravo et al., 2019; Lee et al., 2013). This system is in-place in Pakistan in its funding agencies borrowed way back in 1973 when the National Science Foundation of the United States assisted the framing of funding mechanism of Pakistan while its constitution was being written. So, the recommendation emerges in a nutshell is that the hybrid peer review is working though but its efficacy is to be determined. Currently, an officer inside funding agencies works as a coordinator in the communication between such hybrid peer review system. A direct communication between the scientific researchers and the peer reviewer is not possible. Further, a very good mechanism is in place where all editors and experts sit together to have discussion on multiple research projects and then reach a conclusive decision with mutual wisdom that the research study should be funded or not. This is known as Technical Committee or Bulk Review which still exists in Pakistan Science Foundation but missing in multiple funding agencies, like Higher Education Commission (HEC) of Pakistan, who solely depend upon the single blinded peer review reports to finalize the research funding.

9 Recommendation

One result is absolutely determined that the decision on the basis of Peer Review reports alone would not be sufficient as gender bias can emerge in final grants. The scrutiny committee outcome was satisfactory as gender balance was maintained when 622 projects were shortlisted from 1787 research projects. This committee had deliberations where gender bias did not emerge So, after going through literature studies and our own observations out of this research, it is recommended that after Peer Review, be it single, double or triple blinded, a consultative session should be organized wherein multiple experts should discuss each project having Peer Review reports in front of them to develop

mutual consensus whether a study should be funded or not. This practice might not eliminate gender bias but it will eradicate any chance of gender biased discriminated decisions and the scientific community would be more confident over the final decisions as it will eventually be an outcome of mutual discussion and arguments. Further, the scientific community will have more confidence over the decisions and will focus more on the quality of research citing the fact that its evaluation will be carried out by the dozens of experts at multiple stages before being approved for funding.

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