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Exploring Researchers' Perspectives on Institutional Review Boards Functions in Saudi Arabia: A Survey Utilizing the IRB-RAT Tool

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Abstract

Background The ethics committee has the responsibility to comply with the rules and guidelines regarding oversight of all human research activities, particularly when the research study involves vulnerable people. It also has the role of educating researchers on ethical issues, scientific truthfulness, preventing misconduct and conflicts of interest. In our study we evaluate and benchmark the function of the local ethical committees across the country from the researchers point-of-view.

Methods We employed an online IRB-RAT survey to measure perspectives of investigators towards IRB functions dealing with fairness issues, services, bias, and competences and upholding the rights of the human participants. Two responses were recorded: first shows how important an IRB function is for the investigator in his work, second shows how researchers rate their IRBs in being descriptive in that specific function. The difference of these two scores represent the outcome.

Results We had 179 participants, 166(94%) researchers/research coordinators, and 13(7.2%) IRB members, 94 (53%) participants had been working in the research field for more than 11 years, and the majority 163(90%) revealed that they had IRB contact. The largest gap between actual rating and ideal was observed for the item "An IRB that requires that its chair be an experienced investigator" with a score difference of 1.53. In contrast, the smallest score difference was for the item "Considering the protection of human participants," which had a score of 0.51.

Conclusion According's to researchers point of view; IRBs respect researchers, view human protections as a primary role, do not allow personal bias, maintain accurate records and take timely action whenever misconduct is reported. Further collaborations are needed to enhance IRB performance and to engage researchers in more productive communication with their IRBs.

Keywords IRB functions, Research Ethics, Ethical Committee RECs, Local ethical committees IRB-RAT Tool, Investigators, Research perceptions, Research Roles, Human protections

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Introduction

Institutional Review Boards (IRBs) and Research Ethical Committees (RECs) or so called Local Ethical Committees (LECS) are authorized groups that work to ensure ethical protection of participants and compliance to the regulatory requirements of clinical research that includes human subjects [1, 2].

Research ethics committees have various responsibilities, including protecting the rights of research participants, promoting academic integrity, and being accountable to the wider society affected by the research [3]. These committees can be helpful by providing advice, discussing ethical principles, and addressing problematic study cases [4, 5]. Ethics committees act as a protective barrier between researchers and participants, evaluate the costs and benefits of research, advise on ethical issues, veto unethical research, ensure informed consent and withdrawal, and prevent over-research of certain groups [6].

Investigators worldwide are required to have a certificate of passing a course about basic ethics of research on human subjects, i.e., National Institutes of Health (NIH), Society of Clinical Research Associates (SOCRA) focused on principles of justice, beneficence, respect, research merit and integrity to fulfill the requirements to conduct clinical research in their perspective workplace [7]. However, this course does not reflect the specific roles of local IRBs towards researchers. As a result, tensions between researchers and ethics committees have been reported in several articles [8]. Despite the "moral police" role of the IRBs, they have been criticized by researchers for several reasons, for example delays in the IRB approval and revision process. In addition, IRBs are noticed to deliver unreasonable and inconsistent decisions, they impose excessive bureaucracy and add more pressures to medical practice [9, 10]. Furthermore, the administrative requirements of the ethical regulations increase the time and efforts and in many cases discourage the researchers from seeking the approval [11].

IRBs in a researcher-point-of-view may perceive unfair interactions to investigators [12]. Sometimes they are frustrating because of the long time taken for approval [13]. Moreover, IRBs decisions are absolute and there is little opportunity for the investigators to claim their points. Some of these decisions are not based on logic according to the investigators or they might arise from a clash of egos [14].

On the other hand, researchers seem to have good fair of the concerns as per IRBs member's opinion [15]. Researchers are rushing review of the protocol, they conceal conflicts of interests (COI), and they lack the knowledge about correct informed consent process, have unrealistic assessment of the risks and may not pay attention to the confidentiality of the research participants [9].

Evaluating the effectiveness of an IRB continues to be a difficult task [16]. One of the commonly used validated tools for IRB evaluation is the IRB Researcher Assessment Tool (IRB-RAT), developed by Keith-Spiegel and Koocher in 2005. The purpose of the tool is to evaluate an IRB's function and activities from the researcher's point of view. The questionnaire tool can be used to assess the perceptions of investigators and IRB members regarding the importance of different aspects of IRB functions to them, as well as rating of their IRBs to perform those different aspects compared to ideal [12].

Labude K. a researcher from Singapore used the IRB-RAT tool to gain overall perceived value of ethics review processes; to measure perceptions about local IRB functions and characteristics [17]. Chenneville T. from India as well used IRB-RAT tool to understand how ethical committees currently function which is critical to build infrastructures that support the protection of research participants and improve the scientific quality of health research worldwide [18]. In the United States, Gerber A. studied the IRBs functions in Rowan University at New Jersey using (IRB-RAT) to answer two questions; How do Rowan University IRB member values align with regard to their assessment of their "actual" and "ideal" IRB? and How do Rowan University IRB member ratings provided on the IRB-RAT align with national validation sample data, overall [19]?. Furthermore, JC Roque-Henriquez et al., (2018) has adapted a Spanish IRB-RAT tool which shows sufficient reliability and validity to assist the continuous improvement of the RECs community in Peru and other Spanish-speaking country [20]. Although, other evaluating tools have also been used in many countries and regions, including the Middle East [16], Egypt [21], Africa [22], Pakistan [23], Myanmar [24], Thailand [25], China [26] and the United States [27].

The dynamics of the relationship between research committees and researcher is less frequently investigated, although the mutual benefits of this relationship. Despite the contradictions of perceptions and experiences around IRB functions in other countries, little is known about this in Saudi Arabia. The goal of the study is to assess how the researcher's values align with the actual services of their IRB represented as score by IRB-RAT tool. The score helps to determine areas of improvements in IRB services according to the researchers' in Saudi Arabia. The score can be used to benchmark the performance of the national IRB to other international scores.

Methods

Study design and tool

Cross sectional survey-based using anonymous online self-administered questionnaire. The study tool was designed by professors in Harvard Medical School (HMX) and supported by the NIH in the United States

(Keith-Spiegel and Tabachnick 2006). The survey aimed to assess how investigators viewed 45 IRB functions dealing with fairness issues, services, bias, and competences and upholding the rights of the human participants. A written permission from the authors of the tool has been granted. It consists of 45 questions; every question requires two responses. The first response shows how important an IRB function is for the investigator in his work (scores from 1 = Not important to 7 = essential). The second response is to how researchers rate their IRBs in being descriptive in that specific function (Scores from 1 = Not at all to 7 = highly descriptive). The outcome was mean difference between the two responses. It is generic and could be answered by IRB members, researchers and coordinators. The tool has been validated and used in the U.S and outside (Hall et al. 2015; Chenneville et al. 2014).

Procedure

The questionnaire was built on the REDCap database and was provided with a secure link. The link sent through emails and it started with an invitation and informed consent. If the participant agrees to join the study the survey will open for 10 days and reminders will be sent to the recipient on days 3,5,7 and 9 to ensure higher response rates. The link will not be active once the response is done.

Target

Researchers (physicians, scientists), research coordinators, and IRB members who have published papers in Web of Science (WoS) journals during the past three years. To reach our target population, we communicated with a data expert in Web of Science who helped us -using special codes- to get large lists of authors who were affiliated with at least one Saudi institution (either healthcare or academic) with accredited IRB. Then, we applied systematic randomization to these lists to select our sample. In Saudi Arabia, an IRB is considered to be accredited if its registered and monitored by a central IRB monitoring office that belongs to a governmental body named King Abdul Aziz City for Science and Technology (KACST).

Sample size

The sample size estimated about 320 responses, where the minimum number required from each Saudi institution is six responses (two members, a coordinator, and 3 researchers). We had 53 registered IRBs at the time of data collection.

Ethical approval

The ethical approval was granted from the Research Ethics Committee "REC" of King Faisal Specialist Hospital and Research Center (KFSHRC) Riyadh, Saudi Arabia, Ref# 2,191,278. The REC waived the requirements of signed informed consent. The survey is anonymous and didn't include any identifiers for the participant or the institution. Another approval was sought from National Committee of Bioethics (NCBE), the regulatory body of all IRBs in Saudi Arabia and they considered as decision-makers in this issue. All communications were conducted through official e-mails and saved for auditing purposes. KFSHRC Ethics Committee has reviewed and ethically cleared the final study results. The data were kept confidential with the research team following the Office of Research Affairs (ORA) regulations in KFSH&RC.

Statistical analysis

data were downloaded in JMP pro. 13, assessed for quality and summarized responses rates by types of respondents (IRB member, researcher and Clinical Research Committee, CRC). Scores of the researchers regarding the importance of IRB functions and scores of the rating of their own IRBs functions were calculated as an averages to each item. The difference of these two scores represents outcome and the gap where needs to be explored. Since the data is not normally distributed, the Wilcoxon Sign Rank test was used to compare the significance of the means difference between ideal and actual ratings of each IRB-RAT item. Scatter plots were constructed to show the difference between the scores. Missing values were imputed using the mean of the specific variable since missing were only 4% on average.

Results

We sent an online questionnaire to more than 2000 researchers/research coordinators and IRB members. We were able to collect data from 179 participants, 166(94%) researchers/research coordinators, and 13(7.2%) IRB members, with a response rate of 43%. A large proportion of 94 (53%) participants had been working in the research field for more than 11 years, and 85(47%) had been working for less than 11 years. The vast majority 163(90%) revealed that they had IRB contact.

The importance of the function to work and the actual ratings of each IRB-RAT item are summarized in Table 1. The items are ranked by the mean ratings for the importance of the work from the researchers/research coordinators' and IRB members' perspectives in descending order. Showing which items respondents in our study considered the most and least important. ("Ideal IRB") is what our participants defined as items perceived importance to an ideal IRB while ("Actual IRB") is the degree to which the local IRB could be characterized. The study participants' have recognized the following IRB characteristics as vital: the absence of reviewer and committee biases (6.73), IRB respects the investigators with mean difference (6.8), IRB takes into consideration the

Table 1 Importance of the function to work and actual ratings, ranked in descending order by mean importance ranking, including the mean difference for actual minus importance ratings for each item

Item No#	IRB-RAT Item text	Ideal IRB descriptive	Actual IRB descriptive	Mean difference	95% CI
14	An IRB that treats investigators with respect.	6.8	6.21	0.59	0.43 _ 0.74
29	An IRB whose membership does not allow their personal biases to affect their evaluation of protocols.	6.73	5.73	1	0.78 _ 1.21
42	An IRB that views protection of human participants as its primary function.	6.7	6.19	0.51	0.33 _ 0.68
17	An IRB that maintains complete and accurate records.	6.67	6.01	0.65	0.50 _ 0.81
45	An IRB that takes timely and appropriate action whenever scientific misconduct is alleged.	6.66	5.76	0.9	0.70 _ 1.1
13	An IRB that responds in a timely manner to investigators' inquiries about its processes and decisions.	6.65	5.4	1.25	0.99 _ 1.51
22	An IRB whose members fully understand and act within the scope of their function.	6.64	5.48	1.15	0.93 _ 1.37
35	An IRB whose membership is very knowledgeable about IRB procedures and national policy.	6.64	5.66	0.98	1.76 _ 1.20
33	An IRB that is open to innovative approaches to conducting research.	6.59	5.63	0.95	0.77 _ 1.14
27	An IRB that does a good job of upholding participants' rights while, at the same time, facilitating the conduct of research.	6.55	5.73	0.81	0.62 _ 1.00
32	An IRB that holds no preconceived biases against particular research topics.	6.55	5.64	0.91	0.67 _ 1.14
40	An IRB that conducts a conscientious, informed analysis of potential benefits weighed against potential risks before making decisions.	6.55	5.55	1	0.79 _ 1.20
43	An IRB that takes timely action when an investigator has violated the specifications of its rulings.	6.55	5.57	0.98	0.77 _ 1.19
41	An IRB that has at least one member who is knowledgeable about the content domain and discipline of investigators' protocols.	6.54	5.6	0.94	0.73 _ 1.15
15	An IRB that acknowledges full responsibility for its errors or delays in processing protocols and attempts to correct them as expeditiously as possible	6.53	5.13	1.4	1.12 _ 1.67
37	An IRB that provides a comprehensive training program for its new members.	6.52	5.09	1.42	1.14 _ 1.71
25	An IRB that does not use its power to suppress research that is otherwise methodologically sound and in compliance with national policy whenever it perceives potential criticism from outside the scientific community.	6.51	5.58	0.93	0.70 _ 1.15
31	An IRB that holds no preconceived biases against particular research techniques.	6.51	5.6	0.91	0.68 _ 1.13
1	An IRB that reviews protocols in a timely fashion.	6.5	5.5	0.9	0.7 _ 1.1
30	An IRB that requires members to recuse themselves from evaluating protocols whenever there might be a real or apparent conflict-of-interest.	6.5	5.54	0.95	0.71 _1.18
38	An IRB that is composed of members who arrive at meetings well-prepared.	6.5	5.33	1.17	0.93 _1.141
26	An IRB that shows considerable evidence that the advancement of science is part of its mission.	6.44	5.45	0.98	0.78 _ 1.19
39	An IRB whose Research Compliance Officer (or staff member in charge of IRB functions) has a background in conducting research.	6.44	5.47	0.96	0.73 _ 1.19
4	An IRB that gives a complete explanation for any required changes to or disapprovals of protocols.	6.43	5.51	0.91	0.68 _ 1.14
16	An IRB that is open and pleasant in its interactions with investigators.	6.43	5.26	1.15	0.92 _ 1.40
44	An IRB that applies appropriately flexible standards regarding voluntary and informed consent requirements (e.g., required wording is less demanding for minimal risk research using competent adult participants.)	6.43	5.64	0.78	0.60 _0.97
19	An IRB that requires that its Chair be an experienced investigator.	6.42	4.89	1.53	1.22 _1.83
6	An IRB that is open to reversing its earlier decisions (i.e., willing to carefully listen to investigators' appeals).	6.41	5.37	1.03	0.75 _ 1.31
21	An IRB that is allocated sufficient resources to carry out functions efficiently and thoroughly.	6.4	5.19	1.21	0.93 _ 1.48
24	An IRB that views its role as being an investigator's ally rather than as being a hurdle to clear.	6.39	5.18	1.2	0.95 _ 1.45
34	An IRB that can competently distinguish exempt from nonexempt research.	6.38	5.5	0.88	0.65 _ 1.10
36	An IRB that is composed primarily of highly competent investigators.	6.33	5.43	0.89	0.63 _ 1.15
12	An IRB that is willing to work with investigators to find mutually satisfying solutions whenever disagreements exist.	6.27	5.02	1.25	0.98 _ 1.52

Table 1 (continued)

Item No#	IRB-RAT Item text	Ideal IRB descriptive	Actual IRB descriptive	Mean difference	95% CI
11	An IRB that offers investigators information to improve the chances of gaining IRB approval.	6.26	5.04	1.22	-0.95 _ 1.48
5	An IRB that includes a complete explanation when it denies or mandates changes in a protocol based on criteria that are more stringent than or different from national research policy (i.e., application of "local standards").	6.25	5.31	0.94	0.71 _ 1.17
18	An IRB that monitors the progress of each approved research project in line with national research policy.	6.24	5.2	1.03	0.79 _ 1.27
28	An IRB that is empathetic with the difficulties that can present themselves during the design or conduct of research.	6.24	5.21	1.02	0.80 _ 1.25
9	An IRB that offers investigators opportunities to be educated about national research policy.	6.22	4.77	1.43	1.14 _ 1.73
2	An IRB that conducts a conscientious and complete review of protocols.	6.2	5.6	0.63	0.4 _ 0.8
7	An IRB that invites investigators to present their position whenever a question or concern about a research protocol arises.	6.12	5.15	0.96	0.69 _ 1.23
20	An IRB that has a diverse membership (i.e., includes women, minorities and both junior and senior members of the institution).	5.96	5.28	0.68	0.43 _ 0.93
3	An IRB that recognizes when it lacks sufficient expertise to evaluate a protocol and seeks an outside evaluator.	5.9	5	0.87	0.61 _ 1.13
8	An IRB that offers consultation during the development of research protocols or grant applications.	5.74	4.51	1.23	0.92 _ 1.53
10	An IRB that offers editorial suggestions regarding consent documents and protocols (e.g., typos, grammar, clarity).	5.35	4.52	0.82	0.57 _1.08
23	An IRB that is composed of more than one public member.	5.33	4.41	0.92	0.64 _ 1.20

Table 2 Summary of most and least important items

Most important ideal items	Least important ideal items
14. An IRB that treats investigators with respect.	20. An IRB that has a diverse membership (i.e., includes women, minorities and both junior and senior members of the institution).
29. An IRB whose membership does not allow their personal biases to affect their evaluation of protocols.	3. An IRB that recognizes when it lacks sufficient expertise to evaluate a protocol and seeks an outside evaluator.
42. An IRB that views protection of human participants as its primary function.	8. An IRB that offers consultation during the development of research protocols or grant applications
17. An IRB that maintains complete and accurate records.	10. An IRB that offers editorial suggestions regarding consent documents and protocols (e.g., typos, grammar, clarity).
25. An IRB that takes timely and appropriate action whenever scientific misconduct is alleged.	23. An IRB that is composed of more than one public member.

protection of human participants(6.7), IRB maintains complete and accurate records (6.67), IRB that takes timely and appropriate action whenever scientific misconduct is alleged (6.66), IRB that responds in a timely manner to investigators' inquiries about its processes and decisions (6.65), members fully understand and act within the scope of their function and procedurally and legally knowledgeable members (6.64).

The least important included diverse membership (5.96), seeking an outside evaluator when lacking expertise (5.9), IRB offering consultation or editorial suggestions (5.74), IRB offering editorial suggestions regarding consent documents (5.35), and IRB comprising more than one public member(5.33). The average difference between the importance of the function to work and the actual IRB was calculated from paired data where both ratings were available. We summarized the most and least important items in Table 2.

The average ratings for each of the 45 IRB-RAT items are presented in Fig. 1. The largest gap between actual rating and ideal was (1.53) for item No.19 "An IRB that requires that its Chair be an experienced investigator" and the lowest mean difference was (0.51) for item No.42 "Considering the protection of human participants".

Figure 2 shows that each point plots the average of the actual rating vs. the average difference between the importance of the function to work and the actual rating for a specific item from the IRB-RAT.

Discussion

To our knowledge, this study is the first of its kind in Saudi Arabia to assess how the researcher's values align with the actual services of their IRB, represented as a score by the (IRB_RAT) tool across 45 activities and functions. The findings revealed both areas where RECs performed well and where quality improvement could be applied. Our recruitment pool was not restricted to a single institution, health system, or group of researchers, in contrast to several other published studies that also

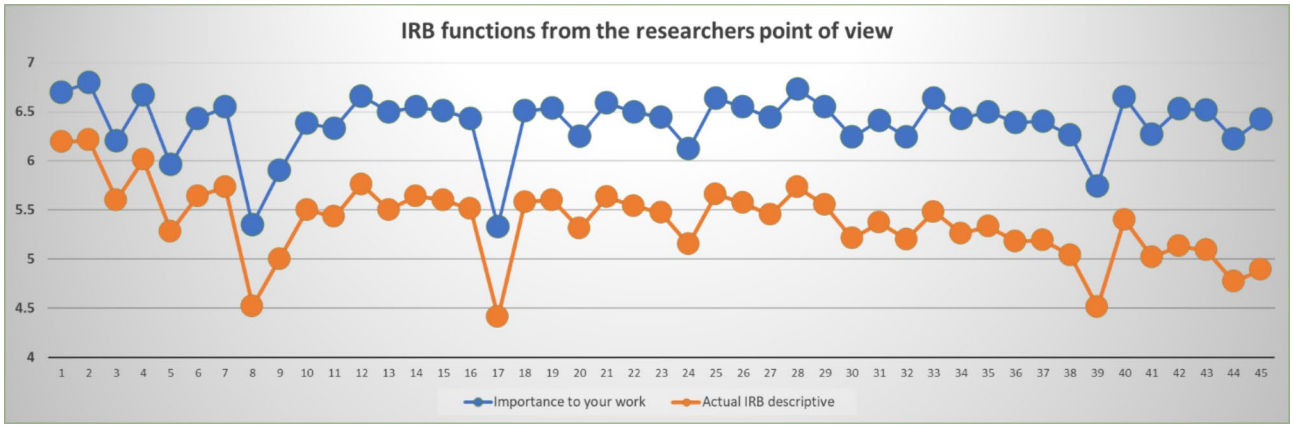

Fig. 1 Item-specific average ratings of the importance of the function to work and actual IRB performance

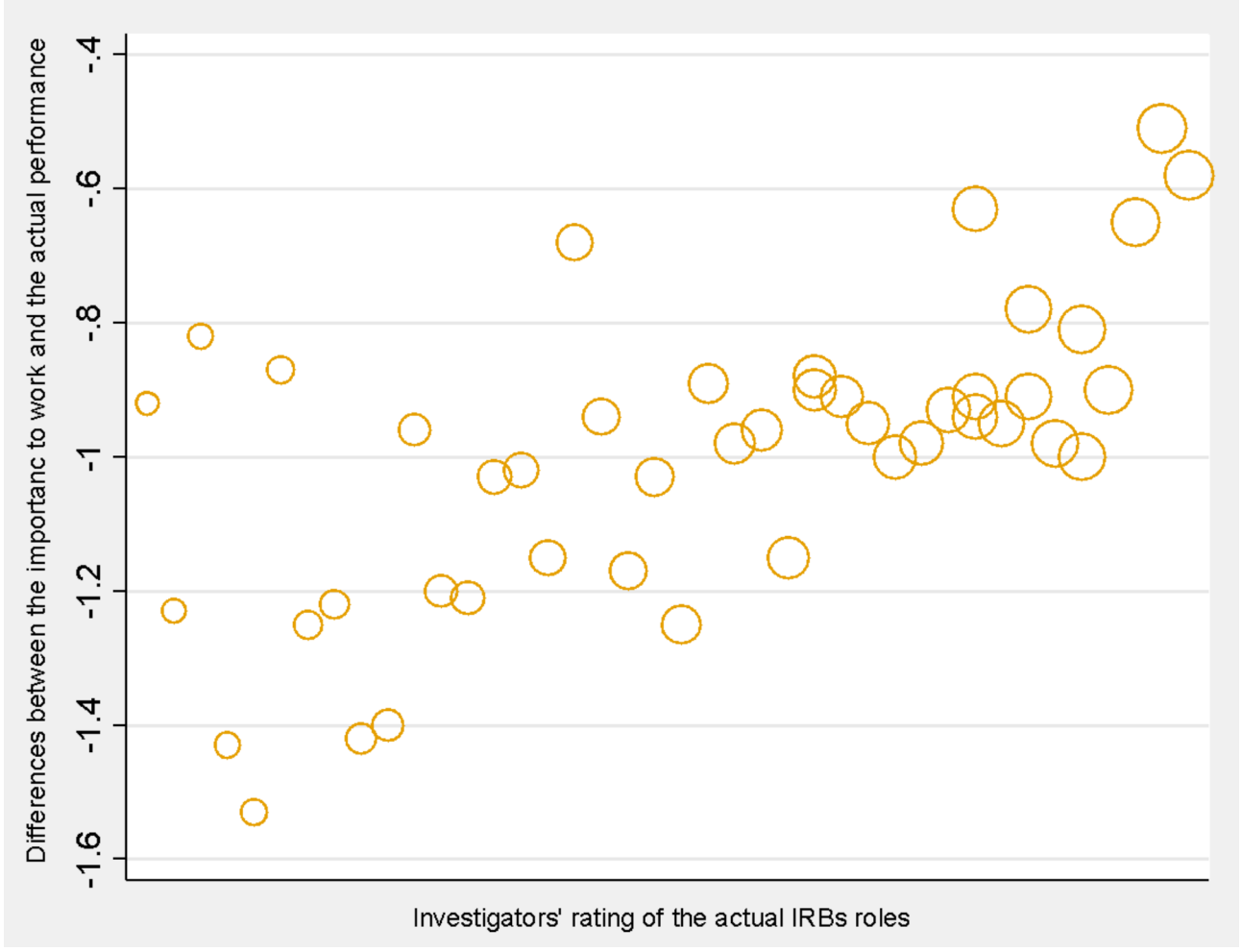

Fig. 2 Differences between the importance of the function to work and actual IRB ratings

used the IRB-RAT; rather, we aimed to include members of the IRBs or ethical committees who have been published research in human subjects for at least three year. Researchers (physicians and scientists) have published papers in Web of Science journals over the previous three years. At the time of this study, ideal ratings were higher than descriptive ratings for each category, pointing to a disparity between the intended and actual functions of IRBs. These findings align with those of an Indian study aimed at assessing Institutional Ethics Committees

in India, which used a slightly modified IRB-RAT tool [18]. This proves that researchers/research coordinators and IRB members have high standards on how well their IRBs should operate. On the other hand, another study aimed at investigating IRB quality using the IRB-RAT tool found that some items had a higher mean actual rating than the ideal. For example, monitors the progress of each approved research project (item 13), requires that its chair be an experienced investigator (item 39), has diverse membership (item 40), offers consultation during the development of research protocols (item 41), offers editorial suggestions regarding consent documents and protocols (item 43), and is composed of more than one public member (item 44) [28].

In assessing the functions and characteristics that are most important for an ideal IRB, a similar pattern of results was obtained in the Indian sample [18]. Chenneville. T. et al. reported that IRB which treats investigators with respect (item 14), an IRB whose membership does not allow their personal biases to affect their evaluation of protocols (item 29), an IRB that maintains complete and accurate records (item 17), and an IRB that takes timely and appropriate action whenever scientific misconduct is alleged (item 25) were among the most essential ideal characteristics for researchers to rate their IRBs. Similarly, our results show that the IRBs are doing a comparatively good job in (Items 14, 29, 17, and 25) in addition to one more, an IRB that views protection of human participants as its primary function (Item 42), which indicates some apparent degree of alignment between Saudi and Indian researcher perspectives on what constitutes an ideal IRB. As a result, the following items were rated as the least essential ideal characteristics for researchers to rate their IRBs: an IRB that has a diverse membership (item 20); An IRB that recognizes when it lacks sufficient expertise to evaluate a protocol (item 3); An IRB that offers consultation during the development of research protocols (item 8); An IRB that offers editorial suggestions (item 10); and An IRB that is composed of more than one public member (item 23), indicating that there is room for improvement for Saudi IRBs in these areas. The similarities between our study and the Indian one are that both have a relatively recent emphasis on challenging research ethical issues.

Labude, M. et al., reported that the largest expectation gap was observed in an IRB that reviews protocols in a timely fashion (Item 1) with a mean difference of 2.83, followed by being viewed as an ally rather than as a hurdle to clear (Item 40); an IRB that is allocated sufficient resources to carry out functions efficiently (Item 21) [17]. In contrast to the work of Labude. M et al., respondents in our study perceived IRBs as falling short of their expectations in these areas: An IRB that requires that its chair be an experienced investigator (Item 19) with the largest mean difference of 1.53, followed by An IRB that offers investigators opportunities to be educated about national research policy (Item 9), and if the IRB provides a comprehensive training program for its new members (Item 37). A recent systematic review in KSA presented the landscape of biomedical research progress, challenges, and prospects through comprehensive bibliometric analyses over the past decade. The review showed that although there has been a linear increase in research publications produced by Saudi researchers over the years, there are challenges related to planning, funding, training, and resource/support barriers at institutional and national levels. This review's key recommendations included releasing effective policies, defining health priorities, building infrastructures, increasing investments, providing high incentives, skilled recruitment, competitive training, and conducting quality and impactful research for the community to help improve biomedical research in this part of the world [29]. The review shows that researchers' demands and expectations from IRBs in Saudi Arabia differ from those in the United States and Singapore due to differences in the duration of the researchers-IRBs interaction, as well as the availability of opportunities and resources. [29].

Another aspect explaining the expectations difference of researchers to functions of IRBs in KSA is the explosion of clinical trials, genomic research, and use of advanced technology methods such as AI research within the past decades. In fact, researchers in our sample had different expectations in two related items: (item 6) an IRB that is open to reversing its earlier decisions and (item 34) an IRB that can competently distinguish exempt from non-exempt research. The growing complexity of AI/data-only research presents substantial hurdles for IRBs, which have previously relied on more traditional research approaches. This transition needs a reevaluation of IRB competence and protocols (i.e., which are considered exempt and which are not) in order to appropriately assess the ethical implications of AI-driven research [30]. This adaptation may require assistance from outside specialists with the appropriate technical understanding to accurately analyze the dangers and advantages of artificial intelligence research, which requires IRB to be open to reverse its decisions based on emerging technology updates [30].

This study has at least two limitations. First, the use of a self-assessment tool may not accurately describe IRB functions. Second, a diverse recruitment pool was not sufficient for our findings to be representative because of the low response rate.

In conclusion, this study represents a significant milestone in the assessment of the alignment between researchers' values and services provided by IRBs in Saudi Arabia. These findings offer critical insights into

the strengths and areas of improvement within RECs, facilitating better research ethics practices. We hope that the outcomes of this study will contribute to the ongoing enhancement of research ethics and protection of human subjects in Saudi Arabia. By pinpointing these specific areas, researchers and IRB members can collaborate to implement targeted strategies for strengthening IRBs functions.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12910-025-01179-4.

Supplementary Material 1

Supplementary Material 2

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Author contributions

AAF supervised the whole study; NB and AS helped in data collection, analysis and writing the draft; AAK helped in study design and editing; AO, YT helped in database design and review of the manuscript; AM, ZK, AmK helped in scientific review of the manuscript.

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Data availability

The questionnaire used for the survey is available as supplementary material in the English translation.The dataset with responses to the questionnaire is available as supplementary material.

Declarations

Ethics approval and consent to participate

The ethical approval was granted from the Research Ethics Committee "REC" of King Faisal Specialist Hospital and Research Center (KFSHRC) Riyadh, Saudi Arabia, Ref# 2191278. The REC waived the requirements of signed informed consent. The survey is anonymous and didn't include any identifiers for the participant or the institution. Another approval was sought from National Committee of Bioethics (NCBE), the regulatory body of all IRBs in Saudi Arabia and they considered as decision-makers in this issue. Authors reporting experiments on humans and/or the use of human tissue samples confirmed that all experiments were performed in accordance with relevant guidelines and regulations. All communications were conducted through official e-mails and saved for auditing purposes. KFSHRC Ethics Committee has reviewed and ethically cleared the final study results. The data were kept confidential with the research team following the Office of Research Affairs (ORA) regulations in KFSH&RC.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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