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RESEARCH ARTICLE

Developing and validating a questionnaire on knowledge and attitudes in health research ethics

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ABSTRACT

Introduction. Research ethics and integrity are fundamental for safeguarding human participants and ensuring trustworthy scientific practices. Understanding researchers' knowledge, attitudes, and perceptions regarding ethical standards is important for all health researchers, but particularly relevant for early-career researchers. While several international instruments exist to evaluate specific aspects of research ethics, such as plagiarism, organizational climate, or responsible conduct of research, a multidimensional and contextually relevant tool is required.

Materials and methods. A comprehensive questionnaire was developed to assess ethical knowledge, attitudes toward research resources and institutional integrity measures, and self-perceived ethical competencies among doctoral students in the health sciences. Item formulation was guided by international standards, including the Declaration of Helsinki, the European Code of Conduct for Research Integrity, and Good Clinical Practice guidelines. The development process included a content validity assessment by 10 experts and a psychometric evaluation of the collected data from 274 doctoral students. Exploratory factor analysis (EFA) was applied to determine the latent structure of the questionnaire, and internal consistency was assessed using Cronbach's alpha.

Results. EFA revealed a six-factor structure explaining 64.5% of the total variance. The factors measured: (I) perceived importance of research resources, (II) self-perceived ethical competencies, (III) implemented institutional measures for research integrity, (IV) ethical principles and moral responsibilities, (V) perceived accessibility of research resources, and (VI) importance of institutional integrity measures. Factor loadings were generally high, and internal consistency was good to excellent, with Cronbach's alpha values ranging from 0.738 to 0.989. These findings indicate that the questionnaire captures multidimensional aspects of research ethics and integrity.

Conclusions. The developed questionnaire represents a robust, valid, and reliable instrument for assessing ethical knowledge and attitudes among researchers in health sciences. It can serve as an internal audit tool to evaluate research integrity climate, researcher satisfaction with available resources, and implementation of institutional policies. Moreover, it provides a foundation for designing targeted training programs and professional development initiatives aimed at improving ethical competencies.

Keywords: research ethics, human subjects, questionnaires, psychometrics, validation studies, medical education.

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Key messages

What is not yet known on the issue addressed in the submitted manuscript

Although several international tools exist for assessing research ethics and integrity, there is a lack of psychometrically validated instruments tailored to the local research context.

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The research hypothesis

It was hypothesized that a contextually adapted and psychometrically validated instrument can reliably capture the multidimensional aspects of researchers' ethical knowledge, attitudes, and perceptions.

The novelty added by the manuscript to the already published scientific literature

This study introduces the first psychometrically validated instrument tailored to the Moldovan research context, capturing multidimensional constructs of research ethics and integrity. The tool complements existing international instruments by providing a context-specific framework for evaluating ethical competence and integrity management.

Introduction

Research ethics in the field of health is not merely a formal obligation but constitutes the foundation for protecting the dignity, rights, and well-being of participants. Research ethics refers to an environment in which moral values, integrity, and transparency are more than just norms written in regulatory documents; they are embedded realities of current research practices. To support the production of ethical research and to foster research environments with a high level of integrity, training in the responsible conduct of research is essential [1]. To foster a culture of research integrity and adapt educational programs on the responsible conduct of research, it is essential to understand researchers' experiences and attitudes toward these issues, particularly among those in the early stages of their careers.

In many countries around the world, studies are conducted to assess the ethical research competencies of early-career researchers. One such example is the study carried out at the Faculty of Medicine of the University of Ljubljana, which evaluated the level of ethical knowledge and attitudes toward research among first-year doctoral students [2]. The findings revealed a very low level of expertise, with an average of only 18.9 correct responses ($p < 0.001$), compared to the expected score of 31 out of 39 questions. Those with prior research experience obtained higher scores. The authors concluded that, to ensure the responsible development of future researchers, more structured and rigorous educational programs in research ethics are necessary.

Another study conducted within a medical faculty in India aimed to assess the level of knowledge, attitudes, and practices related to research ethics among postgraduate students. The results indicated relatively modest average scores for knowledge, attitude, and practice as well. In conclusion, the authors propose the development of an integrated and comprehensive ethics curriculum, combining problem-focused programs with mentorship [3because of the need to improve healthcare. As medical research involves human participants, it has to be guided by fundamental ethical principles to ensure the protection of their rights and welfare. There are very few medical colleges in India with a standardised ethics curriculum, and with provisions for evaluation. This study was done to assess the knowledge, attitude and practices of Medical postgraduate students regarding research ethics. Methods - A one year Cross Sectional Study was done among 154 Postgraduate MD and MS students of medical college. An online questionnaire consisting of questions related to knowledge and attitude towards principles and practice of ethics in clinical research, informed consent, and role of the ethical committee in the institution was given to those who gave consent to participate in the study.Results The Mean ± SD score for Knowledge questions was 8.49 ± 1.65(11].

The study conducted by Hofmann et al. (2020) investigated knowledge, attitudes, and practices related to research integrity among doctoral students from medical faculties at three Scandinavian universities, using a questionnaire based on hypothetical scenarios and attitudes toward questionable research practices. The findings highlighted a diversity of perceptions and practices concerning research integrity, with variations across universities and fields of study. Key observations include: a significant number of respondents reported a willingness to fabricate, falsify, or omit contradictory data if they believed the overall conclusions of the study were correct; nearly one-third of respondents indicated that they had unjustly added one or more authors to their publications. The authors conclude that these results suggest that existing educational and research systems are partially failing to promote research integrity [4Oslo, Odense].

No similar studies have been conducted in the Republic of Moldova. In this context, we decided to develop and validate a questionnaire aimed at supporting the ethical management of research, which would enable the exploration of ethical knowledge regarding the protection of study participants, research integrity, the assessment of attitudes toward the research environment, and the evaluation of perceived ethical competencies. In designing the questionnaire, contextual aspects such as the type of existing training in research ethics, the regulatory framework, and applicable guidelines were taken into consideration.

Materials and methods

The process of developing the questionnaire followed several well-recommended [5, 6] successive stages, namely: 1) questionnaire development; 2) content validity testing; and 3) psychometric analysis, including construct validity testing and internal consistency assessment.

Stage 1. Questionnaire Development. The formulation of the questionnaire items was preceded by the establishment of its conceptual framework and theoretical dimensions. The items were developed based on the international literature on research ethics in the health field, including the World Medical Association Declaration of Helsinki [7] as well as other international guidelines on good research practices and academic integrity, such as the Good Clinical Practice Guideline (ICH GCP E6(R3) [8], and the European Code of Conduct for Research Integrity [9]. The first version of the questionnaire consisted of 79 closed-ended and multiple-choice questions.

Stage 2. Content Validity Testing. Ten experts reviewed the initial version of the questionnaire: four researchers in clinical studies, two researchers in basic science, two researchers in public health, one research manager in the health field, and one ethicist. A qualitative approach was employed, where experts provided a narrative evaluation of each item in terms of clarity, relevance, and domain coverage [10].

Stage 3. Psychometric Evaluation. The questionnaire was sent online (using the Google Forms platform) to doctoral students from the Doctoral School of Medical Sciences at the *Nicolae Testemițanu* State University of Medicine and Pharmacy in the Republic of Moldova, between March and July 2025. Out of 416 doctoral students, 274 responded to the questionnaire, representing a subject-to-item ratio of approximately 4:1. Although this ratio falls slightly below the commonly recommended 5:1 threshold for exploratory factor analysis [5], Kaiser-Meyer-Olkin (KMO) indicators supported the adequacy of the sample, where a KMO index ≥ 0.60 was considered acceptable, while values above 0.80 indicated excellent suitability of the data for factor analysis [13].

After data collection, the construct validity and internal reliability of the questionnaire were assessed. To identify the latent structure of the questionnaire, exploratory factor analysis (EFA) was applied. This method is recommended for the development and validation of psychometric instruments [11, 12]. The number of latent factors was determined based on the eigenvalue criterion (eigenvalues > 1) and examination of the scree plot [14]. Varimax rotation was applied to obtain a clear factor structure [15].

In the next step, the internal consistency of the questionnaire was assessed using Cronbach's alpha, along with the alpha-if-item-deleted analysis for each factor identified, in accordance with psychometric instrument development guidelines [16].

Statistical analyses were performed using Microsoft Excel (Microsoft 365) with the Real Statistics add-in, with a significance threshold set at $p < 0.05$.

Results

Questionnaire Development. A review of the literature in the field contributed to the formulation of 79 items, designed to cover four dimensions: (1) knowledge of ethical standards in research involving human subjects (14 items); (2) attitudes regarding research resources (importance versus accessibility) (21 items); (3) attitudes toward institutional measures aimed at ensuring research integrity (20 items); and (4) participants' self-assessed ethical competencies (14 items). The items were formulated as statements with responses on a 5-point Likert scale, except for questions intended to collect sociodemographic data from participants (10 items).

Content Validity Testing. The initial version of the questionnaire was sent to 10 experts who evaluated its content and provided recommendations and suggestions regarding clarity, relevance, and domain coverage. Based on the experts' feedback, 20 questions were reformulated, and additional items were included in the questionnaire: one question for the sociodemographic section, one open-ended question for each of dimensions 1–3, and two open-ended questions for dimension 4. This resulted in a revised version of the questionnaire consisting of 85 items.

Characteristics of the study participants. Analysis of the respondents' sociodemographic characteristics revealed a predominantly female profile (72.6% [95% CI: 67.1%–77.6%]), with a median age of 35 years and IQR = 32–39 (skewness > 1). Most participants were at an early stage of their research careers, with 0–5 years of research experience (73.4% [95% CI: 67.8%–78.5%]), and the majority had received prior training in research ethics (72.6% [95% CI: 67.1%–77.6%]), primarily through formal instruction sessions. This profile indicates that the sample represents early-career researchers with foundational exposure to ethical training, providing a relevant context for evaluating both the clarity and applicability of the questionnaire items.

Psychometric Analysis. The psychometric analysis was conducted on 70 items; open-ended questions and those aimed at collecting sociodemographic data were excluded from the evaluation. To identify the latent structure of the questionnaire, an exploratory factor analysis (EFA) was performed using the principal component analysis (PCA) extraction method. To assess whether the set of variables (questionnaire items) was suitable for identifying latent factors, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was evaluated. The KMO values for individual items ranged from 0.60 to 0.95, except item 2 (which had a value of 0.33), indicating that, overall, the data were adequate for factor analysis.

According to the Kaiser criterion, 11 factors with eigenvalues values > 1were initially identified. However, to ensure a stable structure, only factors with eigenvalues > 2 were retained, resulting in six factors. The first factor explained 28.33% of the total variance, the second 14.36%, and the third 8.34%. Subsequent factors contributed smaller proportions (5.76%, 4.17%, and 3.57%, respectively). Together, these six factors accounted for approximately 64.5% of

the total variance, indicating a strong capacity of the questionnaire to capture the latent dimensions of the construct under investigation. The Scree Plot [14] confirmed this factor solution by highlighting an "elbow" after the sixth factor, where the slope of the curve levels off. Figure 1 presents the variance of the identified factors.

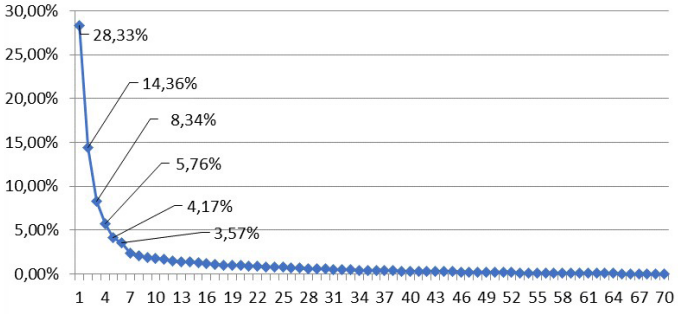

Fig. 1 Variance of the identified factors (Scree Plot).

Note: *The figure shows the eigenvalues for each extracted factor. The "elbow" after the sixth factor, where the curve levels off, supports the retention of a six-factor solution.*

The factor loading matrix was carefully examined to identify the items most strongly associated with each factor. To enhance the interpretability of the loadings for each item (Full Load Matrix), an orthogonal Varimax rotation was applied. Loadings greater than 0.40 were considered significant for inclusion in the factor structure [17, p.151]. Among the 70 items analyzed, 61 items met this threshold, while 2 items had slightly lower loadings of 0.35 and 0.37, respectively. Seven items exhibited loadings below 0.35 and were consequently excluded from further analysis. Overall, 63 items were retained for subsequent psychometric evaluation, ensuring a robust and reliable factor structure for the questionnaire.

For each identified factor, internal consistency was assessed using Cronbach's alpha, with a threshold of ≥ 0.70 considered indicative of satisfactory internal reliability [18]. Additionally, to evaluate the contribution of individual items to the overall coherence of each scale, the alpha-if-item-deleted analysis was conducted.

Analysis of Factor Loadings and Cronbach's Alpha by Factor.

Factor I – Important Research Resources. This factor encompasses items designed to assess participants' perceptions of the importance of various resources essential for conducting good health research. These include adequate funding, research infrastructure, qualified personnel, access to data and databases, clear institutional regulations, interdisciplinary collaborations, administrative and logistical support, sufficient time for research, research and ethics training programs, and mechanisms for study oversight. The items are presented in Table 1.

All items within this factor demonstrated very high factor loadings (ranging from -0.877 to -0.934), indicating a strong coherence and conceptual integrity of the construct. Internal consistency analysis confirmed excellent reliability, with a Cronbach's alpha of 0.989. Furthermore, the alpha-if-item-deleted analysis revealed values ranging from 0.987 to 0.990, with no significant fluctuations, thereby confirming that each item contributes positively to the overall consistency of the scale. These findings are summarized in Table 2.

Table 1. Factor I: *Important Research Resources*

Item	1	2	3	4	5
1. Adequate funding – for equipment, materials, and researchers' salaries.					
2. Research infrastructure – laboratories, analytical technologies, specialized software.					
3. Qualified personnel – researchers, technicians, bioethics specialists, and support staff.					
4. Access to data and databases – relevant sources, previous studies, health registries.					
5. Clear institutional research regulations, including ethical ones – compliant with international and national standards.					
6. Interdisciplinary collaborations – partnerships with other institutions and specialists from various fields.					
7. Administrative and logistical support – managing documentation, procurement, and team coordination.					
8. Sufficient time for research.					
9. Research and ethics training programs – by categories (for beginners, advanced, etc.).					
10. Oversight of study conduct (including research funding and resources).					

Note: *The subjects were asked to indicate the extent to which they agree with the following statements regarding important research resources, using the scale: 1 = not important, 2 = slightly important, 3 = moderately important, 4 = important, 5 = essential.*

Table 2. Statistical analysis of Factor I, including factor loadings and Cronbach's alpha values.

	Items	Loadings	Cronbach's alpha-if-item-deleted
Factor I	Item 1	-0,877	0,990
	Item 2	-0,928	0,987
	Item 3	-0,924	0,987
	Item 4	-0,932	0,987
	Item 5	-0,934	0,987
	Item 6	-0,907	0,988
	Item 7	-0,920	0,987
	Item 8	-0,929	0,987
	Item 9	-0,910	0,988
	Item 10	-0,906	0,988

Note: *Factor loadings represent the correlation between each item and Factor I, extracted through exploratory factor analysis using principal component extraction with varimax rotation. Cronbach's alpha-if-item-deleted indicates the internal consistency of the factor when the respective item is removed. All items were assessed on a Likert-type scale (1-5)*

Factor II – Perceived Ethical Competencies in Research

This factor encompasses items designed to evaluate researchers' self-perceived proficiency in research ethics and scientific integrity. It addresses competencies such as the application of international and national ethical regulations, protection of study participants, obtaining informed

consent, maintaining data confidentiality, responsible data management, and other related ethical practices. All items of the factor are presented in Table 3.

Table 3. Factor II: *Perceived Ethical Competencies in Research*

Item	1	2	3	4	5
1. Application of the principles of the Declaration of Helsinki in research.					
2. Application of national regulations and legislation regarding research on human subjects.					
3. Formulation of feasible study objectives and valid methodology.					
4. Adherence to the principle of equity in recruiting research participants.					
5. Identification and minimization of risks to study participants.					
6. Providing accurate and complete information to study participants and obtaining informed consent.					
7. Protection of the confidentiality of study participants' data.					
8. Completion of the research ethics committee submission dossier.					
9. Seeking advice from colleagues or the ethics committee in moral dilemmas.					
10. Reporting ethical and research integrity issues.					
11. Honest presentation of research results.					
12. Proper citation and avoidance of plagiarism in scientific publications.					
13. Application of ethical authorship principles in research.					
14. Management of conflicts of interest in research.					
15. Data management.					

Note: *The subjects are asked to evaluate their level of preparedness in the following areas/aspects of research, using the following scale: 1 = not at all prepared, 2 = slightly prepared, 3 = moderately prepared, 4 = prepared, 5 = very prepared.*

The factor loadings ranged from 0.614 to 0.857, reflecting a strong and consistent association between the items and the underlying construct. Internal consistency analysis confirmed a high level of reliability, with a Cronbach's alpha of 0.961. Additionally, the "Cronbach's alpha if item deleted" values varied between 0.956 and 0.960, indicating that each item contributes substantially to the overall scale and that none of the items compromises the coherence of the construct. This demonstrates that Factor II provides a robust measure of researchers' perceived ethical competencies in the context of scientific practice. These findings are summarized in Table 4.

Factor III – Measures Implemented to Ensure a Research Integrity Climate

This factor comprises items assessing researchers' attitudes toward the implementation of institutional measures aimed at ensuring research integrity. These include clear policies on integrity, periodic audits and sanctions, promotion of ethical behavior by leadership, management of conflicts of interest, prevention of favoritism and undue influence, plagiarism prevention, and related practices. The questions of Factor III are presented in Table 5.

Table 4. Statistical analysis of Factor II, including factor loadings and Cronbach's alpha values.

	Items	Loadings	Cronbach's alpha-if-item-deleted
Factor II	Item 1	-0,614	0,960
	Item 2	-0,682	0,959
	Item 3	-0,682	0,959
	Item 4	-0,783	0,957
	Item 5	-0,831	0,957
	Item 6	-0,841	0,957
	Item 7	-0,820	0,957
	Item 8	-0,751	0,959
	Item 9	-0,761	0,958
	Item 10	-0,804	0,958
	Item 11	-0,808	0,958
	Item 12	-0,850	0,957
	Item 13	-0,857	0,956
	Item 14	-0,833	0,957
	Item 15	-0,790	0,958

Note: *Factor loadings represent the correlation between each item and Factor II, extracted through exploratory factor analysis using principal component extraction with varimax rotation. Cronbach's alpha-if-item-deleted indicates the internal consistency of the factor when the respective item is removed. All items were assessed on a Likert-type scale (1-5)*

Table 5. Factor III: *Measures Implemented to Ensure a Research Integrity Climate*

Item	1	2	3	4	5
1. Ensuring research integrity through clear policies, monitoring, and strict sanctions.					
2. Promoting moral values in research through education and fostering an academic culture.					
3. Correct and transparent behavior of research leaders.					
4. Periodic checks to prevent data manipulation or falsification in research.					
5. Clear conflict of interest policies and their proper implementation.					
6. Clear and effective measures to prevent favoritism in research.					
7. Clear and effective policies for managing undue influences in research.					
8. Prevention of plagiarism through rigorous checks and clear, effective sanctions.					
9. Accessible and confidential mechanism for reporting incidents of research misconduct.					

Note: *The subjects were asked to indicate the extent to which the listed measures, aimed at ensuring the quality and integrity of research data, are implemented in their institution, using the scale: 1 = not implemented, 2 = limited implemented, 3 = moderately implemented, 4 = well implemented, 5 = fully implemented.*

Factor loadings ranged from 0.777 to 0.881, indicating that all items contribute significantly and coherently to defining the construct. The overall internal consistency for this factor was very high (Cronbach's alpha = 0.989), and the "Cronbach's alpha if item deleted" values ranged between 0.987 and 0.990, confirming that the removal of any single item would not substantially improve the reliability of the scale. These results demonstrate that Factor III provides a robust measure of researchers' perceptions of the implementation of institutional integrity measures. These findings are summarized in Table 6.

Table 6. Statistical analysis of Factor III, including factor loadings and Cronbach's alpha values.

	Items	Loadings	Cronbach's alpha-if-item-deleted
Factor III	Item 1	0,841	0,990
	Item 2	0,848	0,988
	Item 3	0,839	0,987
	Item 4	0,848	0,989
	Item 5	0,858	0,987
	Item 6	0,870	0,987
	Item 7	0,881	0,987
	Item 8	0,777	0,987
	Item 9	0,866	0,987

Note: *Factor loadings represent the correlation between each item and Factor III, extracted through exploratory factor analysis using principal component extraction with varimax rotation. Cronbach's alpha-if-item-deleted indicates the internal consistency of the factor when the respective item is removed. All items were assessed on a Likert-type scale (1-5)*

Factor IV – Ethical Principles and Moral Responsibilities in Research

This factor includes items assessing knowledge of ethical standards in research, such as the rights, safety, and well-being of participants, research integrity, and moral responsibility in human subjects' research. These items are presented in Table 7.

Table 7. Factor IV: *Ethical Principles and Moral Responsibilities in Research*

Item	1	2	3	4	5
1. The rights, safety, and well-being of study participants are the most important considerations in research and should take precedence over the interests of science and society.					
2. Any modification of the research protocol must be approved by the ethics committee before implementation.					
3. Researchers must inform potential study participants about the objectives, procedures, possible risks, and benefits of the study, including any additional information that may help them make an informed decision about participation.					
4. Once a person has been enrolled in a study, it is not advisable to provide information about newly identified risks to avoid causing stress.					
5. Researchers are responsible for protecting the personal data of study participants in accordance with data protection and confidentiality regulations.					
6. Researchers bear no moral responsibility for the well-being and rights of study participants if they are under scientific or financial pressure.					
7. It is impossible to ensure fair and equitable treatment for all participants in a study.					
8. Researchers are responsible for ensuring the transparency and integrity of the data obtained in studies.					
9. Undeclared conflicts of interest can compromise the integrity of research.					
10. Only individuals with professional and ethical competence should be authorized to conduct scientific research on human subjects.					

Note: *The subject is asked to indicate the extent to which they agree with the listed statements, using the scale: 1 = strongly disagree, 2 = partially disagree, 3 = neither agree nor disagree, 4 = partially agree, 5 = strongly agree.*

Factor loadings ranged from -0.353 to -0.692. Items 1 and 10 displayed relatively low loadings, indicating a weaker association with the latent construct; however, they were retained in the analysis due to their theoretical importance, as they address specific dimensions of ethical responsibilities. Overall internal consistency for this scale was satisfactory, with a Cronbach's alpha of 0.738. The "Cronbach's alpha if item deleted" values ranged from 0.697 to 0.733, which is acceptable, although some items had a lower impact on the overall homogeneity of the scale. These results suggest that Factor IV captures key aspects of ethical principles and moral responsibilities, even if certain items contribute less strongly to the latent construct. These findings are summarized in Table 8.

Table 8. Statistical analysis of Factor IV, including factor loadings and Cronbach's alpha values.

	Items	Loadings	Cronbach's alpha-if-item-deleted
Factor IV	Item 1	-0,374	0,725
	Item 2	0,572	0,715
	Item 3	-0,535	0,721
	Item 4	0,692	0,697
	Item 5	-0,452	0,733
	Item 6	0,673	0,698
	Item 7	0,639	0,701
	Item 8	-0,430	0,723
	Item 9	-0,436	0,722
	Item 10	-0,353	0,728

Note: *Factor loadings represent the correlation between each item and Factor IV, extracted through exploratory factor analysis using principal component extraction with varimax rotation. Cronbach's alpha-if-item-deleted indicates the internal consistency of the factor when the respective item is removed. All items were assessed on a Likert-type scale (1-5)*

Within the factor, some loadings are positive while others are negative, which can be explained by the existence of an inverse relationship between those items and the latent factor. In factor analysis, the sign of a loading is relative; what matters is the absolute magnitude of the loading, which indicates the strength of the relationship between the item and the factor.

Factor V – Accessible Research Resources

This factor comprises items assessing researchers' perceptions of the accessibility of resources necessary for conducting research. The factor items are presented in Table 9.

Factor loadings ranged from 0.586 to 0.739, indicating that all items contribute significantly to defining this construct. In comparison, Factor I, which evaluates the perceived importance of the same resources, exhibited substantially higher loadings. This discrepancy may be explained by the fact that researchers generally recognize the intrinsic value of essential research resources. In contrast, their perception of accessibility depends on individual experience and the institutional context in which they operate. Internal consistency for this factor was excellent, with a Cronbach's alpha of 0.912. The "alpha if item deleted" values ranged from 0.898 to 0.912, confirming that each item contributes meaningfully to the overall reliability of the scale. These findings are summarized in Table 10.

Table 9. Factor V: *Accessible Research Resources*

Item	1	2	3	4	5
1. Adequate funding – for equipment, materials, and researchers' salaries.					
2. Research infrastructure – laboratories, analytical technologies, specialized software.					
3. Qualified personnel – researchers, technicians, bioethics specialists, and support staff.					
4. Access to data and databases – relevant sources, previous studies, health registries.					
5. Clear institutional research regulations, including ethical ones – compliant with international and national standards.					
6. Interdisciplinary collaborations – partnerships with other institutions and specialists from various fields.					
7. Administrative and logistical support – managing documentation, procurement, and team coordination.					
8. Sufficient time for research.					
9. Research and ethics training programs – by categories (for beginners, advanced, etc.).					
10. Oversight of study conduct (including research funding and resources).					

Note: *Participants were asked to indicate the extent to which the listed research resources are accessible to them, using the scale: 1 = not accessible, 2 = limited access, 3 = moderate access, 4 = good access, 5 = full access.*

Table 10. Statistical analysis of Factor V, including factor loadings and Cronbach's alpha values.

	Items	Loadings	Cronbach's alpha-if-item-deleted
Factor V	Item 1	0,626	0,911
	Item 2	0,655	0,906
	Item 3	0,675	0,901
	Item 4	0,684	0,902
	Item 5	0,613	0,900
	Item 6	0,693	0,899
	Item 7	0,693	0,899
	Item 8	0,586	0,912
	Item 9	0,739	0,898
	Item 10	0,711	0,898

Note: *Factor loadings represent the correlation between each item and Factor V, extracted through exploratory factor analysis using principal component extraction with varimax rotation. Cronbach's alpha-if-item-deleted indicates the internal consistency of the factor when the respective item is removed. All items were assessed on a Likert-type scale (1-5)*

Factor VI – Important Measures to Ensure a Research Integrity Climate

This factor comprises items assessing the perceived importance of implementing institutional and organizational measures to ensure quality and integrity in research. The factor items are included in Table 11.

Factor loadings were strong, ranging from 0.812 to 0.868, indicating a robust association between each item and the underlying construct. Internal consistency for this factor was very high, with a Cronbach's alpha of 0.974. The "alpha if item deleted" values ranged from 0.969 to 0.973, demonstrating that the removal of any single item would not significantly improve the reliability of the scale. These findings are summarized in Table 12.

Table 11. Factor VI: *Important Measures to Ensure a Research Integrity Climate*

Item	1	2	3	4	5
1. Ensuring research integrity through clear policies, monitoring, and strict sanctions.					
2. Promoting moral values in research through education and fostering an academic culture.					
3. Correct and transparent behavior of research leaders.					
4. Periodic checks to prevent data manipulation or falsification in research.					
5. Clear conflict of interest policies and their proper implementation.					
6. Clear and effective measures to prevent favoritism in research.					
7. Clear and effective policies for managing undue influences in research.					
8. Prevention of plagiarism through rigorous checks and clear, effective sanctions.					
9. Accessible and confidential mechanism for reporting incidents of research misconduct.					

Note: *Participants were asked to indicate which of the listed measures can be considered important for ensuring the quality and integrity of research data, using the scale: 1 = not important, 2 = slightly important, 3 = moderately important, 4 = important, 5 = essential.*

Table 12. Statistical analysis of Factor VI, including factor loadings and Cronbach's alpha values.

	Items	Loadings	Cronbach's alpha-if-item-deleted
Factor VI	Item 1	0,812	0,971
	Item 2	0,823	0,970
	Item 3	0,840	0,970
	Item 4	0,842	0,970
	Item 5	0,859	0,970
	Item 6	0,856	0,971
	Item 7	0,862	0,969
	Item 8	0,868	0,973
	Item 9	0,861	0,970

Note: *Factor loadings represent the correlation between each item and Factor VI, extracted through exploratory factor analysis using principal component extraction with varimax rotation. Cronbach's alpha-if-item-deleted indicates the internal consistency of the factor when the respective item is removed. All items were assessed on a Likert-type scale (1-5)*

Overall, these results indicate that the questionnaire demonstrates robust psychometric properties, with high factor loadings and internal consistency across most factors, supporting its validity for assessing ethical knowledge, attitudes, and perceptions among early-career researchers.

Discussion

The exploratory factor analysis of the questionnaire revealed a multidimensional structure comprising six primary factors, collectively explaining approximately 64.5% of the total variance. Factor loadings were generally high, indicating strong associations between items and their respective constructs. Internal consistency across factors ranged from good to excellent, with Cronbach's alpha values between 0.738 and 0.989.

However, the literature notes that alpha values exceeding 0.95 may indicate potential item redundancy, suggesting that respondents might perceive certain items as overly similar [19]. For instance, within Factor I (Cronbach's alpha = 0.989), items such as adequate funding and administrative support could be interpreted by participants as closely related, reflecting overlapping aspects of the same construct. To minimize potential interpretation ambiguities, each item within the factor was accompanied by a clarifying description. For example, "Adequate funding" referred specifically to resources for equipment, materials, and researcher salaries, whereas "Administrative and logistical support" addressed management of documentation, procurement, and team coordination. While reducing the number of items could potentially decrease redundancy, maintaining a broad range of items ensures that multiple dimensions of the construct are captured. This approach aligns with the exploratory objective of the questionnaire, allowing for a comprehensive assessment of researchers' perceptions and experiences.

Several questionnaires have been developed to assess research ethics and integrity [20prerequisite to goals of subject protection and integrity in research practice. This article presents an update of a 2006 summary of measurement instruments in research ethics with psychometric information in the years 2008–2012. A review of 25 instruments identified seven used in the time period 2008–2012 and which had accumulated at least one study of its psychometric qualities beyond its developmental phase. Many of these instruments had been accumulating psychometric information over more than a decade. Two additional but still underdeveloped instruments addressing important bioethical issues – coercion and therapeutic misconception – are included because they address important issues in research ethics. Bioethicists use a wide range of methods for knowledge development and verification; each method should meet stringent standards of quality. Measurement instruments that meet these standards have the potential to greatly ease the work of institutional review boards and other regulatory bodies as well as to enhance empirical work on human research ethics.","container-title":"Research Ethics","DOI":"10.1177/1747016114538963","ISSN":"1747-0161, 2047-6094","issue":"3","journalAbbreviation":"Research Ethics","language":"en","page":"141-150","source":"DOI.org (Crossref]. For example, Thrush et al. (2007) created a questionnaire to evaluate organizational culture in terms of research integrity, which demonstrated strong content validity (CVI = 0.90) after the removal of problematic items [21].

The SORC questionnaire is considered the first standardized instrument developed to assess organizational climate regarding research integrity [22]. Initially applied among academic researchers in the United States, it has subsequently been adapted and implemented in other cultural contexts [23, 24]. The instrument demonstrated strong reliability, with internal consistency coefficients (Cronbach's alpha) ranging from 0.80 to 0.87.

The questionnaire developed by Mavrinac et al. (2010) is an instrument designed to measure students' attitudes toward plagiarism across three factors: positive attitudes (e.g., perceived acceptability of plagiarism), negative attitudes (e.g., moral disapproval of plagiarism), and subjective norms (e.g., perceived social expectations). Internal consistency coefficients demonstrated good reliability for all three factors (0.83, 0.79, and 0.85), as confirmed through confirmatory factor analysis [25].

The Research Conduct Attitudes Scale is a two-factor instrument assessing (a) the perceived acceptability of ethically questionable research practices and (b) general attitudes toward unethical research behavior [26]. Both factors demonstrated good internal consistency, with Cronbach's alpha values exceeding 0.75.

A valid instrument for assessing researchers' knowledge and attitudes regarding participant rights in studies and research ethics education was developed in Saudi Arabia by Al-Madaney and Fässler [27]. The questionnaire's overall content validity indices exceeded 0.78 for all sections of the questionnaire; the split-half reliability coefficient was 0.755 for knowledge items, and Cronbach's alpha for the attitude scale was 0.77.

All of the studies mentioned share a common objective of operationalizing complex ethical constructs, such as knowledge and attitudes toward plagiarism, organizational climate, responsible conduct of research (RCR), and respect for human subjects' rights. At the same time, these instruments differ in their focus: some target specific domains (e.g., plagiarism), whereas others address broader constructs, such as organizational climate or research integrity culture.

Our study complements existing instruments and contributes to the field through its exploratory nature, targeting multidimensional aspects of research ethics, including the assessment of researchers' knowledge of ethical standards, their perceptions and attitudes toward the research environment, and their confidence in their own moral competencies. The internal consistency of the present questionnaire was very high for the majority of factors, which is comparable to previously published instruments. This questionnaire aligns with national trends in the development of validated instruments in the field of health sciences that are contextually relevant [28].

Even if the study presents a robust, multidimensional instrument for assessing researchers' knowledge and perceptions of ethics and integrity, its generalizability may be limited by the sample characteristics. Future research is recommended to validate the instrument in larger and more diverse populations and to conduct confirmatory factor analysis (CFA) to assess the factor structure of the scale. The questionnaire does not directly assess current ethical practices, highlighting the potential need for more specific instruments to assess distinct ethical behaviors in future studies.

Conclusions

The study demonstrated that the tested questionnaire is a robust and valid instrument for assessing knowledge and attitudes regarding research ethics and integrity in the health sciences. It can serve as an internal audit tool to evaluate the research integrity climate, researchers' satisfaction with available resources, and the implementation of institutional policies. Additionally, the instrument can inform the planning of targeted training programs and professional development initiatives, identifying areas where researchers exhibit insufficient knowledge or understanding of research ethics.

Competing interests

None declared.

Authors' contributions

All the authors participated in the study design, critically reviewed the work, and approved the final version of the manuscript**.**

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Ethics approval and participant consent

The study was approved by the Research Ethics Committee of *Nicolae Testemițanu* State University of Medicine and Pharmacy in the Republic of Moldova, Minutes No.70, dated August 08, 2024. Implicit consent was obtained.

Provenance and peer review

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Use of AI in manuscript preparation.

AI (GPT-4) was used solely to assist in drafting and refining the text; the authors conducted all analyses, interpretations, and conclusions.

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