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Original Article

Current situation and influence factors of scientific integrity in China: A multicenter survey

Xinqiao Liu [a], Yuxin Guo [a], Wenjuan Gao [b], Yu Xie [c], Heling Zhao [c], Jun Du [c,*]

[a] School of Education, Tianjin University, Tianjin, China
[b] Institute of Higher Education, Beihang University, Beijing, China
[c] Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Office of Academic Research, National Cancer Center, National Clinical Research Center for Cancer, Beijing, China

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ABSTRACT

Objective: Cases of scientific misconduct have occurred frequently, especially in the field of medical research. We collected electronic questionnaires from 1257 medical staff in 43 cities and obtained a cross-sectional data set of their understanding of scientific integrity in research. This study aims to propose recommendations for establishing a mature oversight system for research integrity.

Methods: The study employed multiple regression analysis to explore the effect of different factors on the perception of four types of research integrity.

Results: Female participants had a higher understanding of project application integrity than men ($P < 0.001$). Participants in clinical departments had a lower understanding of project application integrity than those in nursing departments (clinical vs. nursing, $P = 0.046$). Participants with a junior college degree or below had a lower understanding than those who had a postgraduate degree and doctoral degree (junior college or below vs. postgraduate degree, $P < 0.001$; junior college or below vs. doctoral degree, $P < 0.001$).

Conclusions: We found that female, medical technology department, advanced education background, and advanced professional titles were significantly associated with a higher understanding of scientific integrity in research in China.

Introduction

Integrity serves as the primary and most important principle of scientific behavior, given that the goal of science is the pursuit of truth.[1] Scientific integrity is the cornerstone of scientific research and the basic academic ethics,[2] which ensures objectivity and reproducibility of research practices.[3] Nonetheless, the higher prevalence of research misconduct in recent years has raised growing concerns about scientific integrity worldwide.[4] Research misconduct is defined as "fabrication, falsification, or plagiarism in proposing, conducting, reviewing, or reporting research results and other practices that deviate seriously from those commonly accepted within the scientific community for proposing, conducting, or reporting research" by The Office of Research Integrity from the Department of Health & Human Services.[5] In fact, scientific misconduct has become a global concern, with reports of plagiarism, falsification, and falsification of data and research results from different countries.[6] A recent meta-analysis found that 2%–14% of scientists from high-income countries are likely to fabricate or falsify data.[7] Studies have also noticed that the incidence of scientific misconduct is significantly higher in middle and less developed countries than in developed countries.[8,9]

In recent decades, China's research output has increased with the quality of research steadily improving,[10] although confronted with the challenges of scientific misconduct.[11] Particularly with the high number of papers that have been retracted due to misconduct, the integrity of Chinese researchers has come under growing scrutiny and criticism.[12] Thus, the Chinese government has paid great attention and introduced a series of regulations to address this issue.[13] For instance, the General Office of the State Council in China issued "Several Opinions on Further Strengthening the Construction of Scientific Integrity (2018)" to improve the management and accountability mechanism of scientific integrity.[14] In addition, China has upgraded its scientific integrity management model with the unremitting efforts of the government and institutions.[3]

* *Corresponding author.*
E-mail address: dujun@cicams.ac.cn (J. Du).

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Some relevant research found no significant differences in the occurrence of scientific misconduct among different identity groups, such as students, faculty, and so on.[15] However, other studies suggested that men were more likely to violate scientific integrity[10,15] and that gender differences might result from a combination of biological and sociocultural factors.[16] In terms of disciplines, several studies have indicated that scientific integrity issues are more severe in the biomedical field[1,6,11] and that scientific misconduct occurs to a large extent in biomedical research.[17] Undoubtedly, scientific misconduct in medical research is more likely to lead to catastrophic consequences. Therefore, the issue of scientific integrity in the medical field is of the most significant concern.[18,19] Among the factors contributing to scientific misconduct, personal ethical failures, pressure from various sources, such as publication, promotion, and obtaining external funding, as well as insufficient education on scientific integrity, are considered to be the main factors that lead to the occurrence of scientific misconduct.[20] To some extent, the great pressure researchers face is related to the unreasonable evaluation system. Therefore, the extant literature suggests that universities, hospitals, and other research institutions should provide regular education on scientific integrity to raise awareness of scientific misconduct in the academic field. A scientific evaluation system should also be established to emphasize research quality.[4,7,17,21]

Medical research is tightly linked with human health, and it is urgent and necessary to establish a mature regulatory system for scientific integrity. There are few studies on the perceptions of scientific integrity among frontline medical workers in China due to the unavailability of relevant data. In this way, this study analyzed the perceptions and influencing factors of scientific integrity among 1257 frontline medical professionals from 43 cities of 23 provinces across China through a nationwide survey, aiming to provide statistical support for establishing a medical scientific integrity prevention system and reducing research misconduct effectively.

Methods

Participants

Medical staff working in hospitals were invited to participate in this study from November 2 to November 19, 2020, via an online questionnaire platform. The study complied with the Declaration of Helsinki. The informed consent of the participants was obtained during the data collection process, and all participants understood and agreed that their answers to the questionnaires would be used for the analyses and reports. The ethical approval was acquired from the Research Ethics Committee of Cancer Hospital, Chinese Academy of Medical Sciences.

The present study's inclusion criterion was medical staff currently working in hospitals; the exclusion criterion was questionnaires with incomplete information.

Questionnaire design and implementation

To conduct this research, we designed a questionnaire on the scientific integrity of research among the medical staff. The questionnaire included four parts: (1) Basic information on the participants, such as hospital level and department category; (2) daily work status, such as publishing papers, presiding project status, and so on; (3) organizational environmental support, such as scientific research support conditions of the hospitals, training and education on scientific integrity, and so on; (4) scientific research attitudes and behaviors, such as understanding of different scientific research misconduct, and so on. The perception of research integrity is the core of our concern.

According to the internationally recognized Fabrication Falsification Plagiarism rules and the documents and norms of scientific integrity for Chinese researchers formulated by the Ministry of Science and Technology and the Ministry of Education, we divide the perception of scientific integrity in research into three parts, including the integrity perception of scientific publication, integrity perception of project application, and integrity perception of scientific research review. We designed three measurement scales in the questionnaire to measure participants' three levels of integrity understanding. The scale for integrity perception of scientific publication includes a total of 13 items, and each item uses a Likert scale of 7 points; the Cronbach's α of the scale was 0.981. The integrity perception of project application is gauged with 7 items, each of which also uses a 7-point Likert scale, and the Cronbach's α of the scale is 0.984. The measure of integrity perception of scientific research review contains 5 items, each using a 7-point Likert scale, and the Cronbach's α is 0.994. Therefore, the three scales have high reliability, good stability, and consistency. In the follow-up analysis, we averaged the scores of all items of each scale, which represents the level of understanding of each type of scientific integrity in research.

The sample size was determined with a single population proportion formula assuming a power of 80%, 5% margin of error, an effect size of 10%, and a non-response rate of 10%, which yields a sample size of 1168. Thus, we finally included 1257 participants in the study. A cluster sampling technique was employed to select the study participants. Initially, according to the regional division of China's National Bureau of Statistics, we randomly selected 13, 10, and 10 out of 13,445, 10,019, and 10,890 hospitals (clusters) in eastern (including Beijing, Hebei, Tianjin, Shandong, Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong), central (including Jilin, Anhui, Jiangxi, Henan, Hubei, Hunan, Heilongjiang), and western (including Sichuan, Guizhou, Qinghai, Xinjiang, Gansu, Chongqing) China, respectively. Afterward, we included all eligible participants in the hospitals (clusters). We adopted convenience sampling in this study. The electronic questionnaire was distributed to 1257 participants from 43 cities and 23 provinces in hospitals by the WeChat platform.

Data analysis

The descriptive results were expressed as frequencies and percentages. Each item of familiarity with scientific integrity and misconduct concept was assigned 1 to 7 points (from "completely do not know" to "completely know") and was described as the means $\pm$ SD. Familiarity with scientific integrity and misconduct concepts was classified into 3 grades: grade 1 (0–3 points), grade 2 (4 points), and grade 3 ($\geq$ 5 points). We used proportion to describe categorical variables. The relationship between variables and familiarity with scientific integrity and misconduct concept was analyzed using linear regression. A P-value < 0.05 was considered statistically significant. The survey data were analyzed using STATA 15.1.

Results

Characteristics of the participants

A total of 1257 medical workers were enrolled in this study, of which 917 (72.95%) were female and 340 (27.05%) were male. There were 625 (49.72%) participants aged 30–39 years, 336 (26.73%) participants under the age of 30, 230 (18.30%) participants aged 40–49 years, and 66 (5.25%) participants aged 50–59 years. As for the geographical distribution, 643 (51.15%) participants came from the eastern region, 372 (29.59%) from the central region, and 242 (19.25%) from the western region. At the hospital level, most of the participants (72.71%) came from tertiary and first-class hospitals. Regarding the type of hospital, most of the participants (55.37%) came from affiliated hospitals of universities. As for the category of departments, the number of participants in the clinical department was the largest, with 819 (65.16%), followed by nursing department participants, with a total of 247 (19.65%), and the number of participants in the medical technology department was the lowest, with only 191 (15.19%).

From the perspective of education background, 468 (37.23%) held a undergraduate degree, 331 (26.33%) had a postgraduate degree, 300

(23.87%) had a doctorate degree, and only 158 (12.57%) had a junior college degree or below. Furthermore, 432 (34.37%) participants had junior titles, 430 (34.21%) participants had intermediate titles, 197 (15.67%) and 114 (9.07%) participants had senior deputy titles and senior titles, respectively, and only 84 (6.68%) participants had no professional titles. Among them, there were 140 (11.14%) graduate tutors.

258 (20.53%) held administrative posts in the department. A total of 173 (13.76%) had served as reviewers of academic journals, and 75 (5.97%) had acted as national- or provincial-level project evaluation experts. In addition, 108 (8.59%) and 238 (18.93%) participants were principal investigators/co-investigators or team members in the national projects and provincial projects, respectively (Table 1).

Situation of credit of scientific research

825 (65.63%) participants reported that their hospital provided research integrity education courses, and 194 (15.43%) participants reflected that the hospital did not. Additionally, 238 (18.93%) participants did not know whether the hospital had the courses. Regarding whether the academic committee would cope with misconduct behavior, 878 (69.85%) participants reported that the academic committee would do so, while 379 (30.15%) participants reported that the academic committee would not do so. Regarding violating the integrity of scientific research would be "vetoed by one vote" at the time of promotion, 971 (77.25%) reported it was true, while 286 (22.75%) reported it was not (Table 1).

Situation of the understanding of misconduct in scientific research

Based on the score of participants' recognition of specific scientific research misconduct, we evaluated participants' understanding of scientific research misconduct (the higher the score, the worse they act in scientific integrity, vice versa) and obtained the following results.

Integrity perception of scientific publication

Regarding selectively publishing research results by eliminating data that contradicts your research assumptions, 723 (57.52%) participants scored less than 4 points, 257 (20.45%) participants scored 4 points, 277 (22.04%) participants scored more than 4 points, and the mean ± SD was 2.89 ± 2.02. As for ghostwriting papers, 829 (65.95%) participants scored less than 4 points, 216 (17.18%) participants scored equal to 4 points, 212 (16.87%) participants scored more than 4 points, and the mean ± SD was 2.53 ± 1.93. 808 (64.28%) participants scored less than 4 points in erroneous paper citations, 242 (19.25%) participants scored equal to 4 points, 207 (16.47%) participants scored more than 4 points, and the mean ± SD was 2.58 ± 1.91. Regarding modifying and beautifying images and data to obtain anticipated results, 778 (61.89%) participants scored less than 4 points, 259 (20.60%) participants scored equal to 4 points, 220 (17.50%) participants scored more than 4 points, and the mean ± SD was 2.67 ± 1.92. Regarding repeatedly publishing similar data and pictures, 852 (67.78%) participants scored less than 4 points, 215 (17.10%) participants scored equal to 4 points, 190 (15.12%) participants scored more than 4 points, and the mean ± SD was 2.43 ± 1.90. Regarding stealing others' research results and preemptively publishing, 881 (70.09%) participants scored less than 4 points, 207 (16.47%) scored equal to 4 points, 169 (13.44%) scored more than 4 points, and the mean ± SD was 2.29 ± 1.87. Regarding improperly quoted papers to improve the citation rate, 879 (69.93%) participants scored less than 4 points, 204 (16.23%) participants scored equal to 4 points, 174 (13.84%) participants scored more than 4 points, and the mean ± SD was 2.34 ± 1.85. As for unethical authorship, 814 (64.76%) participants scored less than 4 points, 253

Table 1
Characteristic of participants ($N = 1257$).

Variables	*n*	Percentage (%)
District		
Eastern region	643	51.15
Central region	372	29.59
Western region	242	19.25
Hospital level		
Tertiary and first-class hospitals	914	72.71
Tertiary and secondary hospitals	31	2.47
Tertiary hospital	185	14.72
Others	127	10.10
Type of hospital		
Affiliated hospitals of universities	696	55.37
Non-university affiliated teaching hospitals	265	21.08
Others	296	23.55
Category of departments		
Clinical departments	819	65.16
Medical technology department	191	15.19
Nursing department	247	19.65
Age (years)		
< 30	336	26.73
30–39	625	49.72
40–49	230	18.30
≥ 50	66	5.25
Gender		
Female	917	72.95
Male	340	27.05
Education background		
Junior college or below	158	12.57
Undergraduate	468	37.23
Postgraduate	331	26.33
Doctoral degree	300	23.87
Professional title		
Senior	114	9.07
Deputy senior	197	15.67
Intermediate	430	34.21
Junior	432	34.37
No	84	6.68
Graduate tutor		
No	1117	88.86
Yes	140	11.14
Talent title		
No	1147	91.25
Yes	110	8.75
Administrative position		
No	999	79.47
Yes	258	20.53
Academic editor of academic journals		
No	1172	93.24
Yes	85	6.76
Reviewer of academic journals		
No	1084	86.24
Yes	173	13.76
National or provincial project review expert		
No	1182	94.03
Yes	75	5.97
National project		
No	1149	91.41
Yes	108	8.59
Provincial and ministerial level projects		
No	1019	81.07
Yes	238	18.93
Research integrity education courses		
No	194	15.43
Yes	825	65.63
Do not know	238	18.93
Whether academic committee would cope with misconduct behavior		
No	379	30.15
Yes	878	69.85
Violating the integrity of scientific research would be "vetoed by one vote" at the time of promotion		
No	286	22.75
Yes	971	77.25

(20.13%) participants scored equal to 4 points, 190 (15.12%) scored more than 4 points, and the mean ± SD was 2.56 ± 1.86. Regarding fabricating the funding of articles, 910 (72.39%) participants scored less than 4 points, 199 (15.83%) participants scored equal to 4 points, 148 (11.77%) participants scored more than 4 points, and the mean ± SD was 2.21 ± 1.80. Regarding contributing the same manuscript to different publishers, 875 (69.61%) participants scored less than 4 points, 212 (16.87%) participants scored equal to 4 points, 170 (13.52%) participants scored more than 4 points, and the mean ± SD was 2.35 ± 1.87. Regarding ignoring known mistakes in our own published research results, 915 (72.79%) participants scored less than 4 points, 195 (15.51%) participants scored equal to 4 points, 147 (11.69%) participants scored more than 4 points, and the mean ± SD was 2.18 ± 1.78. Regarding casually reporting others to reduce their high competitiveness, 926 (73.67%) participants scored less than 4 points, 184 (14.64%) participants scored equal to 4 points, 147 (11.69%) participants scored more than 4 points, and the mean ± SD was 2.15 ± 1.79. Regarding tutors who did not supervise students' misconduct in scientific research, 872 (69.37%) participants scored less than 4 points, 210 (16.71%) participants scored equal to 4 points, 175 (13.92%) participants scored more than 4 points, and the mean ± SD was 2.37 ± 1.86 (Table 2).

Integrity perception of project application

For naming uninvolved superior leaders in the research group, 810 (64.44%) participants scored less than 4 points, 271 (21.56%) participants scored equal to 4 points, 176 (14.00%) participants scored more than 4 points, and the mean ± SD was 2.56 ± 1.81. For applying for projects in the name of a professor ahead of time, 892 (70.96%) participants scored less than 4 points, 230 (18.30%) participants scored equal to 4 points, 135 (10.74%) participants scored more than 4 points, and the mean ± SD was 2.28 ± 1.75. For exaggerating their own contributions to the research project, 893 (71.04%) participants scored less than 4 points, 217 (17.26%) participants scored equal to 4 points, 147 (11.69%) participants scored more than 4 points, and the mean ± SD was 2.26 ± 1.78. For using similar studies to apply for multiple projects, 880 (70.01%) participants scored less than 4 points, 225 (17.90%) participants scored equal to 4 points, 152 (12.09%) participants people scored more than 4 points, and the mean ± SD was 2.34 ± 1.76. For plagiarizing or fabricating key contents of the project declaration, 930 (73.99%) participants scored less than 4 points, 187 (14.88%) participants scored equal to 4 points, 140 (11.14%) participants scored more than 4 points, and the mean ± SD was 2.11 ± 1.75. Regarding listing others as participants and signing without consent, 931 (74.07%) participants scored less than 4 points, 189 (15.04%) participants scored equal to 4 points, 137 (10.90%) participants scored more than 4 points, and the mean ± SD was 2.11 ± 1.74. For bribing project reviewers for approval, 931 (74.07%) participants scored less than 4 points, 188 (14.96%) participants scored equal to 4 points, 138 (10.98%) participants scored more than 4 points, and the mean ± SD was 2.1 ± 1.76 (Table 2).

Integrity perception of scientific project review

With regard to making unfair evaluations of peer research results, 909 (72.32%) participants scored less than 4 points, 191 (15.19%) scored equal to 4 points, 157 (12.49%) people scored more than 4 points, and the mean ± SD was 2.18 ± 1.79. With regard to the use of position or own influence to influence review, 910 (72.39%) participants scored less than 4 points, 191 (15.19%) scored equal to 4 points, 156 (12.41%) scored more than 4 points, and the mean ± SD was 2.18 ± 1.80. With regard to perjuring to others' experimental or research achievements, 914 (72.71%) participants scored less than 4 points, 196 (15.59%) scored equal to 4 points, 147 (11.69%) scored more than 4 points, and the mean ± SD was 2.15 ± 1.79. With regard to consulting and reviewing in unfamiliar fields for friends, 906 (72.08%) participants scored less than 4 points, 205 (16.31%) scored equal to 4 points, 146 (11.61%) scored more than 4 points, and the mean ± SD was 2.18 ± 1.79. With regard to the reviewer obtaining and using the applicant's design or results, 908 (72.24%) participants scored less than 4 points, 198 (15.75%) scored equal to 4 points, 151 (12.01%) scored more than 4 points, and the mean ± SD was 2.17 ± 1.80 (Table 2).

Table 2
Specific improper behavior of scientific integrity in research ($N = 1257$).

Items	< 4, *n* (%)	4, *n* (%)	> 4, *n* (%)	Mean ± SD
Integrity perception of scientific publication				
Selectively eliminating data and publishing research results	723 (57.52)	257 (20.45)	277 (22.04)	2.89 ± 2.02
Ghostwriting of dissertations and entrusting others to submit	829 (65.95)	216 (17.18)	212 (16.87)	2.53 ± 1.93
Erroneous paper citation	808 (64.28)	242 (19.25)	207 (16.47)	2.58 ± 1.91
Modifying and beautifying the images and data	778 (61.89)	259 (20.60)	220 (17.50)	2.67 ± 1.92
Repeatedly publishing modified similar data and picture	852 (67.78)	215 (17.10)	190 (15.12)	2.43 ± 1.90
Stealing others' study information and pre-emptively publishing	881 (70.09)	207 (16.47)	169 (13.44)	2.29 ± 1.87
Improperly quoting papers to improve the citation rate	879 (69.93)	204 (16.23)	174 (13.84)	2.34 ± 1.85
Wrongly naming leaders or colleagues as authors	814 (64.76)	253 (20.13)	190 (15.12)	2.56 ± 1.86
Fabricating the fund of articles to publish easily	910 (72.39)	199 (15.83)	148 (11.77)	2.21 ± 1.80
Contributing the same manuscript to different publishers	875 (69.61)	212 (16.87)	170 (13.52)	2.35 ± 1.87
Ignoring known mistakes in own published research results	915 (72.79)	195 (15.51)	147 (11.69)	2.18 ± 1.78
Casually reporting others to reduce their high competitiveness	926 (73.67)	184 (14.64)	147 (11.69)	2.15 ± 1.79
Tutors didn't supervise students' misconduct	872 (69.37)	210 (16.71)	175 (13.92)	2.37 ± 1.86
Integrity perception of project application				
Naming uninvolved leaders in the research group	810 (64.44)	271 (21.56)	176 (14.00)	2.56 ± 1.81
Applying for projects in the name of a professor ahead of time	892 (70.96)	230 (18.30)	135 (10.74)	2.28 ± 1.75
Exaggerating own contributions in research project	893 (71.04)	217 (17.26)	147 (11.69)	2.26 ± 1.78
Using similar studies to apply for multiple projects	880 (70.01)	225 (17.90)	152 (12.09)	2.34 ± 1.76
Plagiarizing or fabricating the key contents of declaration	930 (73.99)	187 (14.88)	140 (11.14)	2.11 ± 1.75
Listing others as a participant and signing without the consent	931 (74.07)	189 (15.04)	137 (10.90)	2.11 ± 1.74
Bribing project reviewers for approval	931 (74.07)	188 (14.96)	138 (10.98)	2.10 ± 1.76
Integrity perception of scientific projects review				
Making an unfair evaluation of peer research results	909 (72.32)	191 (15.19)	157 (12.49)	2.18 ± 1.79
Using of position or own influence to influence review	910 (72.39)	191 (15.19)	156 (12.41)	2.18 ± 1.80
Perjuring for others' experimental or research achievements	914 (72.71)	196 (15.59)	147 (11.69)	2.15 ± 1.79
Consulting and review in unfamiliar fields for friends	906 (72.08)	205 (16.31)	146 (11.61)	2.18 ± 1.79
Reviewer obtaining and using the applicant's design or results	908 (72.24)	198 (15.75)	151 (12.01)	2.17 ± 1.80

Multivariable regression analysis

Integrity perception of scientific publication

In multivariable regression analysis, female participants had a higher understanding of project application integrity than men ($P < 0.001$). Participants in clinical departments tended to have a lower sense of integrity in project application than those in medical technology departments ($P = 0.050$), while participants with a junior college degree or below had a lower understanding than those with undergraduate degrees, postgraduate degrees, and doctoral degrees (bachelor degree or below vs. undergraduate degrees, $P = 0.013$; bachelor degree or below vs. postgraduate degree, $P < 0.001$; bachelor degree or below vs. doctoral degree, $P < 0.001$). Participants with senior titles had a higher understanding than those without professional titles ($P = 0.009$). Participants who had not served as graduate tutors tended to have a higher understanding than those who had served (no vs. yes, $P = 0.070$), and those who had no administrative position tended to have a lower understanding than those who had (no vs. yes, $P = 0.086$) (Table 3).

Integrity perception of project application

In multivariable regression analysis, participants in clinical departments had a lower understanding of project application integrity than those in nursing departments (clinical vs. nursing, $P = 0.046$), and females had a higher knowledge than men (female vs. male, $P < 0.001$). Participants with a junior college degree or below had a lower understanding than those with a postgraduate degree and doctoral degree (bachelor's degree or below vs. postgraduate degree, $P < 0.001$; bachelor's degree or below vs. doctoral degree, $P < 0.001$) but tended to have a lower understanding than those with an undergraduate degree (bachelor's degree or below vs. undergraduate degree, $P = 0.068$). Participants with senior titles had a higher understanding than those with no titles and tended to have a higher understanding than those with junior titles (senior vs. no, $P = 0.002$; senior vs. junior, $P = 0.075$). Participants who had no administrative position tended to have a lower understanding than those who had (no vs. yes, $P = 0.055$). Participants who did not serve as graduate tutors tended to have a higher understanding than those who did (no vs. yes, $P = 0.028$). Participants from hospitals where academic committees would not cope with misconduct in scientific research had a higher understanding than participants from hospitals where academic committees would do so (yes vs. no, $P = 0.033$) (Table 4).

Integrity perception of scientific research review

In multivariable regression analysis, participants from tertiary and first-class hospitals tended to have a lower understanding of scientific research review integrity than those from tertiary and secondary hospitals ($P = 0.057$). Participants in the clinical department had a lower understanding than those in medical technology departments, while they had a higher understanding than those in nursing departments (clinical

Table 3
Multivariable regression analysis of integrity perception of scientific publication.

Variables	Estimate	Std. Err	*F*	*P*	95% Conf. Interval
District (based on eastern region)					
Central region	0.134	0.121	1.100	0.270	(–0.104, 0.371)
Western region	−0.089	0.136	−0.650	0.513	(–0.356, 0.178)
Hospital level (based on tertiary and first-class hospitals)					
Tertiary and secondary hospitals	−0.334	0.300	−1.110	0.266	(–0.922, 0.255)
Tertiary hospital	−0.085	0.202	−0.420	0.674	(–0.481, 0.311)
Others	−0.175	0.231	−0.760	0.448	(–0.627, 0.277)
Type of hospital (based on affiliated hospitals of universities)					
Non-university affiliated teaching hospitals	0.091	0.119	0.770	0.443	(–0.142, 0.324)
Others	0.069	0.163	0.420	0.672	(–0.251, 0.390)
Category of departments (based on clinical departments)					
Medical technology department	−0.231	0.117	−1.960	0.050	(–0.461, 0.000)
Nursing department	0.231	0.146	1.580	0.115	(–0.056, 0.518)
Age (based on < 30)					
30–39	−0.049	0.151	−0.320	0.748	(–0.345, 0.248)
40–49	0.224	0.228	0.980	0.327	(–0.224, 0.672)
≥ 50	−0.229	0.283	−0.810	0.419	(–0.785, 0.327)
Gender (based on women)	0.456	0.111	4.120	< 0.001	(0.239, 0.673)
Education background (based junior college or below)					
Undergraduate	−0.513	0.206	−2.490	0.013	(–0.918, –0.108)
Postgraduates	−1.159	0.241	−4.810	< 0.001	(–1.632, –0.686)
Doctoral degree	−1.278	0.275	−4.650	< 0.001	(–1.817, –0.739)
Professional title (based on senior)					
Deputy senior	0.188	0.209	0.900	0.368	(–0.222, 0.599)
Intermediate	0.258	0.258	1.000	0.317	(–0.248, 0.763)
Junior	0.450	0.285	1.580	0.115	(–0.109, 0.101)
No	0.909	0.346	2.630	0.009	(0.231, 1.587)
Graduate tutor (based on “No”)	0.330	0.182	1.810	0.070	(–0.028, 0.687)
Talent title (based on “No”)	0.178	0.160	1.110	0.267	(–0.136, 0.492)
Administrative position (based on “No”)	−0.239	0.139	−1.720	0.086	(–0.511, 0.034)
Academic editor of academic journals (based on “No”)	0.051	0.208	0.250	0.806	(–0.356, 0.458)
Reviewer of academic journals (based on “No”)	−0.140	0.147	−0.950	0.341	(–0.427, 0.148)
National or provincial project review expert (based on “No”)	−0.340	0.213	−1.600	0.111	(–0.757, 0.078)
National project review expert (based on “Yes”)	0.013	0.183	0.070	0.942	(–0.347, 0.373)
Provincial project review expert (based on “Yes”)	−0.023	0.139	−0.160	0.871	(–0.295, 0.249)
Research integrity education courses (based on “Yes”)					
No	0.134	0.142	0.940	0.347	(–0.145, 0.413)
Do not know	−0.058	0.127	−0.460	0.647	(–0.307, 0.191)
Whether academic committee would cope with misconduct behavior (based on “Yes”)	0.176	0.126	1.400	0.163	(–0.072, 0.423)
Violating the integrity of scientific research would be “vetoed by one vote” at the time of promotion (based on “Yes”)	0.174	0.122	1.430	0.154	(–0.065, 0.414)
Constant	2.305	0.757	3.050	0.002	(0.821, 3.789)

$R^2 = 0.1415$.

Table 4
Multivariable regression analysis of integrity perception of application for scientific research projects.

Variables	Estimate	Std. Err	*F*	*P*	95% Conf. Interval
District (based on eastern region)					
Central region	0.091	0.119	0.760	0.446	(–0.143, 0.325)
Western region	−0.137	0.133	−1.030	0.302	(–0.399, 0.124)
Hospital level (based on tertiary and first-class hospitals)					
Tertiary and Secondary hospitals	−0.537	0.309	−1.740	0.083	(–1.144, 0.070)
Tertiary hospital	−0.185	0.205	−0.900	0.367	(–0.588, 0.218)
Others	−0.141	0.235	−0.600	0.550	(–0.602, 0.321)
Type of hospital (based on affiliated hospitals of universities)					
Non-university affiliated teaching hospitals	0.032	0.120	0.270	0.787	(–0.203, 0.268)
Others	0.003	0.164	0.020	0.985	(–0.318, 0.324)
Category of departments (based on clinical departments)					
Medical technology department	−0.219	0.117	−1.870	0.061	(–0.449, 0.010)
Nursing department	0.296	0.148	1.990	0.046	(0.005, 0.587)
Age (based on < 30)					
30–39	−0.137	0.153	−0.900	0.369	(–0.437, 0.162)
40–49	0.212	0.232	0.920	0.360	(–0.242, 0.667)
≥ 50	−0.096	0.282	−0.340	0.733	(–0.649, 0.457)
Gender (based on women)	0.529	0.110	4.800	< 0.001	(0.313, 0.745)
Education background (based junior college or below)					
Undergraduate	−0.378	0.207	−1.830	0.068	(–0.784, 0.028)
Postgraduates	−0.889	0.241	−3.690	< 0.001	(–1.362, –0.416)
Doctoral degree	−1.073	0.270	−3.970	< 0.001	(–1.602, –0.543)
Professional title (based on senior)					
Deputy senior	0.102	0.199	0.510	0.609	(–0.289, 0.493)
Intermediate	0.350	0.250	1.400	0.162	(–0.140, 0.841)
Junior	0.492	0.276	1.780	0.075	(–0.049, 1.034)
No	1.041	0.340	3.060	0.002	(0.374, 1.707)
Graduate tutor (based on “No”)	0.376	0.171	2.190	0.028	(0.040, 0.712)
Talent title (based on “No”)	0.092	0.147	0.620	0.532	(–0.196, 0.380)
Administrative position (based on “No”)	−0.270	0.141	−1.920	0.055	(–0.546, 0.006)
Academic editor of academic journals (based on “No”)	−0.041	0.206	−0.200	0.843	(–0.444, 0.363)
Reviewer of academic journals (based on “No”)	−0.095	0.146	−0.650	0.515	(–0.383, 0.192)
National or provincial project review expert (based on “No”)	−0.260	0.214	−1.220	0.224	(–0.679, 0.159)
National project review expert (based on “Yes”)	−0.079	0.178	−0.450	0.655	(–0.428, 0.269)
Provincial project review expert (based on “Yes”)	−0.032	0.137	−0.230	0.817	(–0.300, 0.237)
Research integrity education courses (based on “Yes”)					
No	0.186	0.147	1.270	0.206	(–0.102, 0.475)
Do not know	−0.003	0.125	−0.020	0.984	(–0.248, 0.243)
Whether academic committee would cope with misconduct behavior (based on “Yes”)	0.271	0.127	2.130	0.033	(0.022, 0.521)
Violating the integrity of scientific research would be “vetoed by one vote” at the time of promotion (based on “Yes”)	0.160	0.124	1.290	0.196	(–0.083, 0.403)
Constant	1.954	0.736	2.650	0.008	(0.510, 3.399)

$R^2 = 0.1314$.

vs. medical technology, $P = 0.046$; clinical vs. nursing, $P = 0.017$), and females had a higher understanding than men (female vs. male, $P < 0.001$). Participants with a junior college degree or below had a lower understanding than those who had a postgraduate degree and doctoral degree (junior college or below vs. postgraduate degree, $P < 0.001$; junior college or below vs. doctoral degree, $P < 0.001$), while they tended to have a lower understanding than those who held an undergraduate degree (junior college or below vs. undergraduate degree, $P = 0.063$). Participants with senior titles had a higher understanding than those without titles and tended to have a higher understanding than those with junior titles (senior vs. no, $P = 0.009$; senior vs. junior, $P = 0.070$). Participants who did not serve as graduate tutors tended to have a higher understanding than those who did (no vs. yes, $P = 0.066$) (Table 5).

Integrity perception of scientific integrity in research

In multivariable regression analysis, participants in the clinical department had a lower understanding than those in the medical technology departments, while they tended to have a higher understanding than those in nursing departments (clinical vs. medical technology, $P = 0.043$; clinical vs. nursing, $P = 0.053$), and females had a higher understanding than men (female vs. male, $P < 0.001$). Participants with a junior college degree or below had a lower understanding than those with an undergraduate degree, postgraduate degree, or doctoral degree (bachelor's degree or below vs. undergraduate degree, $P = 0.023$; bachelor's degree or below vs. postgraduate degree, $P < 0.001$; bachelor's degree or below vs. doctoral degree, $P < 0.001$). Participants with senior titles had a higher understanding than those with no titles (senior vs. no, $P = 0.004$). Those who had not served as graduate tutors had a higher understanding than those who had served (no vs. yes, $P = 0.044$). Participants with no administrative position tended to have a lower understanding than those who had (no vs. yes, $P = 0.068$) (Table 6).

Discussion

The study conducted a nationwide survey to assess the present status, perceptions of scientific integrity among frontline medical professionals in China, and factors influencing the perceptions of scientific integrity. It is the first multicenter report that reveals the status, recognition, and influencing factors of scientific integrity, which can help us promote scientific integrity's publication and establish a mature system of preventing misconduct in scientific integrity.

Understanding and improving scientific integrity in China's medical community

First, efforts should be made to provide scientific integrity education courses and to carry penalties for violating scientific integrity, which is in line with some existing studies' findings.[6,11]

Table 5
Multivariable regression analysis of integrity perception of review of scientific research projects.

Variables	Estimate	Std. Err	*F*	*P*	95% Conf. Interval
District (based on eastern region)					
Central region	0.074	0.126	0.590	0.556	(–0.173, 0.321)
Western region	−0.109	0.142	−0.770	0.442	(–0.388, 0.170)
Hospital level (based on tertiary and first-class hospitals)					
Tertiary and Secondary hospitals	−0.615	0.323	−1.910	0.057	(–1.248, 0.018)
Tertiary hospital	−0.139	0.218	−0.640	0.522	(–0.566, 0.288)
Others	−0.078	0.247	−0.310	0.754	(–0.562, 0.407)
Type of hospital (based on affiliated hospitals of universities)					
Non-university affiliated teaching hospitals	0.047	0.126	0.380	0.708	(–0.200, 0.294)
Others	0.035	0.177	0.200	0.841	(–0.312, 0.383)
Category of departments (based on clinical departments)					
Medical technology department	−0.242	0.121	−1.990	0.046	(–0.480, –0.004)
Nursing department	0.381	0.159	2.400	0.017	(0.069, –0.693)
Age (based on < 30)					
30–39	−0.147	0.162	−0.910	0.363	(–0.465, 0.170)
40–49	0.106	0.243	0.440	0.663	(–0.370, 0.582)
≥ 50	0.011	0.296	0.040	0.971	(–0.571, 0.592)
Gender (based on women)	0.636	0.116	5.480	< 0.001	(0.408, 0.863)
Education background (based junior college or below)					
Undergraduate	−0.405	0.217	−1.860	0.063	(–0.831, 0.022)
Postgraduates	−0.972	0.255	−3.820	< 0.001	(–1.471, –0.473)
Doctoral degree	−1.180	0.287	−4.110	< 0.001	(–1.743, –0.617)
Professional title (based on senior)					
Deputy senior	0.140	0.210	0.670	0.505	(–0.272, 0.553)
Intermediate	0.381	0.262	1.450	0.147	(–0.134, 0.896)
Junior	0.529	0.292	1.810	0.070	(–0.043, 1.101)
No	0.935	0.355	2.630	0.009	(0.238, 1.631)
Graduate tutor (based on “No”)	0.330	0.180	1.840	0.066	(–0.022, 0.683)
Talent title (based on “No”)	0.105	0.161	0.660	0.512	(–0.210, 0.421)
Administrative position (based on “No”)	−0.248	0.152	−1.630	0.104	(–0.546, 0.051)
Academic editor of academic journals (based on “No”)	0.015	0.212	0.070	0.943	(–0.401, 0.431)
Reviewer of academic journals (based on “No”)	−0.164	0.150	−1.090	0.276	(–0.458, 0.131)
National or provincial project review expert (based on “No”)	−0.161	0.212	−0.760	0.449	(–0.577, 0.256)
National project review expert (based on “Yes”)	−0.057	0.183	−0.310	0.754	(–0.417, 0.302)
Provincial project review expert (based on “Yes”)	−0.030	0.143	−0.210	0.835	(–0.311, 0.251)
Research integrity education courses (based on “Yes”)					
No	0.127	0.150	0.840	0.400	(–0.168, 0.421)
Do not know	0.019	0.130	0.150	0.881	(–0.236, 0.275)
Whether academic committee would cope with misconduct behavior (based on “Yes”)	0.163	0.134	1.220	0.224	(–0.100, 0.426)
Violating the integrity of scientific research would be “vetoed by one vote” at the time of promotion (based on “Yes”)	0.112	0.130	0.860	0.389	(–0.143, 0.366)
Constant	1.833	0.767	2.390	0.017	(0.329, 3.337)

$R^2 = 0.1295$.

Second, the respondents' perception of scientific misconduct was generally proper in publishing scientific research results, project application, and scientific research review. However, some medical staff showed a noticeable lack of awareness in the following four aspects, ie, (1) selectively publishing findings in their favor, (2) modifying and embellishing images and data to get the desired effect, (3) naming uninvolved leaders in the research group, and (4) using similar studies to apply to multiple projects. The findings reflect that there is still a partial lack of awareness among medical staff about scientific misconduct, and China still needs to strengthen education on scientific integrity among researchers.[12,13]

Finally, the multiple regression analysis showed that women, the medical technology sector, higher educational levels, and higher titles were significantly associated with higher perceptions of scientific integrity. Specifically, female participants had a higher understanding of scientific integrity than males. A possible reason is that women were more afraid of admitting or committing scientific misconduct than men.[19,21] It also suggested that female participants had a higher understanding of integrity, which could be ascribed to the inherent difference of gender nature. Testosterone could reduce generosity, which might cause misconduct in scientific research, but it still needed to be verified in this field.[22] Furthermore, participants from different departments had different levels of understanding of scientific integrity. Those in clinical departments had a lower sense of scientific integrity than those in medical technology departments, which might be related to the fact that clinicians were busy with clinical work and devoted relatively less time to research activities. Additionally, the level of education was directly proportional to the level of understanding of scientific integrity in research, which might be related to the courses on scientific integrity provided in higher education institutions. Students at the undergraduate level and above were required to take courses related to research integrity, receive training in academic ethics and norms, and complete the appropriate assessments before graduating. It was noteworthy that participants who were not graduate student mentors had a higher understanding of research integrity than those who had been graduate student mentors. This might be attributed to the fact that graduate student advisors not only faced the dual pressure of teaching and research but also had the burden of helping graduate students to complete their academic assessments. Thus, some graduate student mentors might cross the boundary of scientific integrity. Therefore, it is necessary to strengthen the selection, evaluation, and training of masters or Ph.D. supervisors regarding research skills and scientific integrity. In this way, it will help the graduate student mentors to play a better role as role models so that the graduate students can have a more comprehensive and deeper understanding of scientific integrity.[1] Besides, medical professionals with senior/higher titles had higher perceptions of integrity, which might be attributed to their higher level of education and ethics, or due to the less external pressure.

Table 6
Multivariable regression analysis of perception of scientific integrity in research.

Variables	Estimate	Std. Err	*F*	*P*	95% Conf. Interval
District (based on eastern region)					
Central region	0.110	0.117	0.940	0.349	(–0.120, 0.340)
Western region	−0.107	0.131	−0.820	0.415	(–0.363, 0.150)
Hospital level (based on tertiary and first-class hospitals)					
Tertiary and Secondary hospitals	−0.447	0.296	−1.510	0.132	(–1.029, 0.135)
Tertiary hospital	−0.124	0.198	−0.620	0.533	(–0.513, 0.265)
Others	−0.146	0.228	−0.640	0.523	(–0.594, 0.302)
Type of hospital (based on affiliated hospitals of universities)					
Non-university affiliated teaching hospitals	0.066	0.116	0.570	0.570	(–0.162, 0.294)
Others	0.044	0.159	0.280	0.783	(–0.269, 0.357)
Category of departments (based on clinical departments)					
Medical technology department	−0.230	0.113	−2.030	0.043	(–0.452, –0.008)
Nursing department	0.279	0.144	1.940	0.053	(–0.004, 0.562)
Age (based on < 30)					
30–39	−0.093	0.147	−0.630	0.527	(–0.382, 0.196)
40–49	0.197	0.224	0.880	0.380	(–0.243, 0.637)
≥ 50	−0.144	0.277	−0.520	0.603	(–0.687, 0.399)
Gender (based on women)	0.512	0.107	4.790	< 0.001	(0.302, 0.722)
Education background (based junior college or below)					
Undergraduate	−0.454	0.199	−2.280	0.023	(–0.844, –0.603)
Postgraduates	−1.046	0.232	−4.510	< 0.001	(–1.501, –0.591)
Doctoral degree	−1.201	0.263	−4.560	< 0.001	(–1.717, –0.685)
Professional title (based on senior)					
Deputy senior	0.155	0.199	0.780	0.437	(–0.235, 0.544)
Intermediate	0.308	0.247	1.250	0.213	(–0.177, 0.793)
Junior	0.478	0.273	1.750	0.080	(–0.057, 1.012)
No	0.951	0.332	2.860	0.004	(0.299, –1.603)
Graduate tutor (based on “No”)	0.343	0.170	2.010	0.044	(0.009, 0.677)
Talent title (based on “No”)	0.139	0.147	0.950	0.343	(–0.149, 0.428)
Administrative position (based on “No”)	−0.249	0.137	−1.830	0.068	(–0.517, 0.019)
Academic editor of academic journals (based on “No”)	0.018	0.196	0.090	0.926	(–0.366, 0.402)
Reviewer of academic journals (based on “No”)	−0.132	0.142	−0.930	0.351	(–0.410, 0.146)
National or provincial project review expert (based on “No”)	−0.282	0.202	−1.400	0.163	(–0.678, 0.114)
National project review expert (based on “Yes”)	−0.027	0.176	−0.150	0.879	(–0.373, 0.319)
Provincial project review expert (based on “Yes”)	−0.027	0.135	−0.200	0.844	(–0.292, 0.239)
Research integrity education courses (based on “Yes”)					
No	0.147	0.140	1.050	0.292	(–0.127, 0.421)
Do not know	−0.027	0.123	−0.220	0.826	(–0.268, 0.214)
Whether academic committee would cope with misconduct behavior (based on “Yes”)	0.200	0.123	1.620	0.105	(–0.042, 0.442)
Violating the integrity of scientific research would be “vetoed by one vote” at the time of promotion (based on “Yes”)	0.158	0.119	1.320	0.186	(–0.076, 0.392)
Constant	2.113	0.729	2.900	0.004	(0.682, 3.543)

$R^2 = 0.1434$.

Implications for nursing practice and research

Compared with previous research, the study provides information support for establishing a medical scientific integrity system by investigating front-line medical workers in China and obtaining first-hand data.[23] The investigation of misconduct can be more detailed, such as the proportion of plagiarism, misquotation, modification of data, and other misconduct separately, to acquire a more targeted understanding of misconduct and allocate the supervision resources more efficiently. The investigation of the necessity of providing integrity courses can be applied to medical school students, as it has been documented that misconduct in medical scientific research was also common among students.[24]

Limitations

There are several limitations in this study. First, all researchers in this survey were medical workers from national medical centers in China. The results could represent the present situation, recognition, and influencing factors of scientific integrity to some extent, but the sample size was still insufficient. Further studies should be conducted with larger sample sizes from global scenarios. Second, given that scientific integrity cognition included moral judgments and that the participants might tend to beautify their perception of scientific integrity, the self-reported questionnaire might lead to some measurement bias.

Conclusions

The main conclusions of this study are as follows. First, further efforts should be made to provide research integrity courses and to carry penalties for violating scientific integrity. Second, researchers' understanding of scientific misconduct was generally proper in publishing scientific research results, project application, and scientific research review. Third, women, the medical technology sector, higher educational levels, and higher titles were significantly associated with higher perceptions of scientific integrity.

Ethics statement

The experimental protocol was established, according to the ethical guidelines of the Helsinki Declaration. The written informed consent of the participants was obtained over the data collection process, and the ethical approval was exempted from the Research Ethics Committee of Cancer Hospital, China Academy of Medical Sciences.

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CRediT author statement

Jun Du designed the study. **Xinqiao Liu** undertook the statistical analysis. **Xinqiao Liu, Yuxin Guo, Wenjuan Gao, Yu Xie, Heling Zhao and Jun Du** wrote the article and polished the full text. All authors read and approved the final manuscript. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author, J.D. The data are not publicly available due to restrictions their containing information that could compromise the privacy of research participants.

Declaration of Generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

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