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Perceptions of occurrence of research misconduct and related factors among Kenyan investigators engaged in HIV research

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ABSTRACT

We report on occurrence and correlates of self-reported research misconduct (RM) by 100 Kenyan researchers who had received ethics approval for an HIV research in the 5 years preceding the survey. The survey used the Scientific Misconduct Questionnaire-Revised tool uploaded on a Research Electronic Data Capture (REDCAP) platform. The response rate was low at 17.3% (100 out of 577) with 53.9% reporting awareness of an incident of RM *in the preceding 5 years*. Awareness was associated with being in academia, perception of vulnerability to being caught, and the severity of possible punishment, if discovered. Two-thirds (68.3%) reported *ever-involvement* in any misconduct. Self-report of involvement in misconduct was associated with knowledge of rules and procedures on RM and a disposition to support such rules and regulations. Nearly 36% reported *ever-involvement* infabrication, falsification and/or plagiarism (FFP). Self-report of ever-involvement in FFP was associated with number of years in the academic position, perceived likelihood of being caught, and the perceived severity of the sanctions, if caught. We conclude that the occurrence of RM is not uncommon, and efforts to create awareness about RM as well as to establish institutional structures and policies on RM are needed.

KEYWORDS

research misconduct; HIV researchers; Kenya

Introduction

Research misconduct (RM) is a significant but insidious threat to the research enterprise globally. It is often defined as deliberate fabrication, falsification, and plagiarism (FFP) in proposing, performing, reporting, and/or reviewing research (Steneck 2006; Gupta 2013; Kakuk 2009; Awais 2013). Some definitions have focussed on the three so-called 'cardinal sins' of fabrication, falsification and plagiarism (FFP), while others have expanded the definition of RM to what are also called questionable research practices (QRPs). The US National Science Foundation defines RM as FFP (National Science Foundation 2019), while in Europe, the dominant definition is

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broader – including FFP and QRPs as documented in the European Code of Conduct for Research Integrity by All European Academies (ALLEA 2017). In other literature, fabrication and falsification are also considered as research fraud being among the kind of behaviors that demonstrate the highest level of intent to cheat (Fang, Grant Steen, and Casadevall 2012). Other authors include plagiarism together with fabrication and falsification as fraud (Gupta 2013).

The reasons for occurrence of RM are said to range from personal and professional to inadequate capacity for research oversight in working environment. Personal and professional reasons include the need for fame and prestige, deliberate failure in diligently carrying out repetitive study measurements, pressure to achieve promotion or secure tenure, and lack of training or experience in ethical research. Institutional weaknesses may include lack or low level of oversight, perceptions about rules governing scientific conduct, penalties and rewards, and training and mentorship (Gupta 2013; Davis, Riske-Morris, and Diaz 2007; George 2016).

Prevalence of RM

Studies have attempted to document the occurrence of RM (Gupta 2013; Fanelli 2009; Fang, Grant Steen, and Casadevall 2012; Okonta and Rossouw 2013). Most of the studies on the prevalence of RM depend on self-report. A review of 2047 retracted biomedical journal articles indexed in PubMed in 2012 (1975–2012) reported that 67.4% were due to misconduct of which 43.4% were as a result of fraud (fabrication and falsification) (Fang, Grant Steen, and Casadevall 2012). This report also estimated that there has been a 10-fold rise in retractions of papers due to fraud since 1975. In the Middle East (Bahrain, Egypt, and Lebanon), surveying 278 researchers documented that 59.4% self-reported at least one RM, while 74.5% reported knowledge of colleagues' involvement in RM (Felaefel et al. 2018). Overall, there were self-reports of fraud by 28.6% of respondents. Lack of ethics training was an important predictor of the occurrence of RM. A study in the lower and middle-income countries (LMICs) including China, Bangladesh, India, Tunisia, Nigeria, South Africa, Mexico, Costa Rica, Guatemala, and Uruguay reported that RM does occur in these countries, but systems to address it are either weak or nonexistent (Ana et al. 2013). In a systematic review of the occurrence of RM in high-income economies, including the United States of America and the United Kingdom, it was estimated that 2 −14% of researchers may have committed fabrication or falsification while the same study estimated that 33–75% of researchers may have committed QRPs (Fanelli 2009). Respondents tended to report a lower rate of self-involvement in RM and higher rates when referring to colleagues' involvement in RM. In Nigeria, similarly high estimates of the prevalence of RM

have been reported with an estimated 68.9% having committed at least one RM while 42% had either falsified or plagiarized (Okonta and Rossouw 2013). Evidently, RM is not uncommon in the LMICs.

Correlates of RM

Pressure to publish, as a metric for academic progression, and inadequate knowledge of research ethics have been linked to the occurrence of RM. Specifically, acknowledgment of insufficient knowledge of research ethics has been identified as a predictor of admitting the previous commission of RM (Adeleye and Adebamowo 2012). A more pernicious correlate is the desire to produce cutting-edge research that moves the field forward and with potential for commercialization through intellectual property claims (Kakuk 2009). Other correlates of occurrence of RM include perceptions of weak institutional regulatory frameworks that either have low capacity to catch perpetrators or do not have clear and deterrent sanctions against commission of RM (Okonta and Rossouw 2014; Pryor, Habermann, and Broome 2007; Davis, Riske-Morris, and Diaz 2007).

Methodological challenges in studying RM

Several critiques have been made of studies on the prevalence of RM. One critique is that the tools used do not adequately discriminate if participants reporting RM are referring to the same case or different cases of RM. The second challenge in identifying and measuring RM is the cultural and regional disparities in what is considered misconduct or not. While fabrication and falsification of data are globally considered unacceptable and amount to scientific fraud, plagiarism is much more culturally and geographically nuanced and specific. What is considered plagiarism in the western cultures may be argued to be a depiction of the cultural reverence of authority and an aversion to paraphrasing an expert's wording that would alter the original meaning – implying lack of skills in technical writing and referencing (Ellery 2008). Additionally, use of English as a foreign language leads some authors to thinking in their local language and writing in English making plagiarism attractive (Simpson 2016). Moreover, the western culture has been considered more print oriented compared to other more oral cultures such as African culture, perhaps, increasing the likelihood of plagiarism among researchers of African background. Additionally, the western perception of ideas as private property that can be commoditized emphasizes individualism, while the African and other collectivist perspectives focus on sharing (Allen 2019). The fact that even in the western world, ideas are a mix of own ideas, ideas read, and ideas discussed makes for careful reflection before labeling a work as plagiarized (Angélil-Carter 2014). Nonetheless,

there is a global consensus that the wholesale reproduction of other people's works without adequate and appropriate attribution is unacceptable and considered plagiarism. What appears to be contentious is what level of similarity between the original and the plagiarized work should be sanctioned.

In the measurement of RM, there are few validated tools for assessing exposure to or occurrence of RM. The study documenting RM in Africa (Okonta and Rossouw 2013) adopted the Scientific Misconduct Questionnaire-Revised (SMQ-R). The original SMQ tool was developed in Indiana (Broome et al. 2005) and has been validated in Africa and adapted and used by Okonta and Rossouw (2013). Moi University, among other Kenyan institutions of higher education , experiences the same anxieties about the apparently increasing prevalence of RM and its potential impact on the scientific enterprise. However, like many other Kenyan and African institutions of higher learning, the institution lacks a robust framework for preventing and managing RM. We report on the self-reported occurrence of RM as a baseline for a three-phased project that aimed at developing a Kenya national consensus on a modular framework for preventing and managing RM. For ease of comparison with previous studies, we used SMQ-R tool. In this baseline report, we aimed to estimate the prevalence of RM and factors associated with self-reports of RM by HIV researchers from Kenya.

Methods

Study design and setting

This was a cross-sectional study using quantitative methods. Data were collected on an online survey from 13 April to 6 May 2018 among Kenyan researchers.

Study participants

The study participants were researchers who had submitted and received approval for an HIV-based research project from any one of the accredited research ethics committees (REC) in Kenya in the 5 years preceding the survey. The focus on HIV research was a funding requirement. In Kenya, all health research is approved under a delegated mandate from the National Commission for Science, Technology and Innovation (NACOSTI) underpinned by the Science and Technology Act 2013 (National Commission for Science Technology and Innovation 2013). As part of the accreditation requirements, all RECs submit an annual report which details the research proposals approved together with the contacts of the principal investigators. NACOSTI, in turn, has worked in collaboration with the National AIDS

Control Commission (NACC) (National AIDS Control Council 2019) to develop and regularly publish the research work being implemented in the area of HIV and AIDS at a website called *Maisha Maarifa* (National AIDS Control Council – Maisha maarifa research hub 2019). At the time of the survey, there were 22 accredited RECs that were regularly reporting to NACOSTI and from whose approval HIV-related research was published in the *Maisha Maarifa* platform.

Study procedures

The study tool

We requested for and obtained permission to use the SMQ from the original concept developer (Broome et al. 2005). The tool contains 50 closed-ended questions all organized in seven sections. The closed-ended questions focussed on the following: demographics of the participants and their workplace, participants' perception of the work environment, beliefs on occurrence of scientific misconduct at place of work, awareness of occurrence of Scientific Misconduct (SM) at work station, beliefs and attitudes about SM, and behavioral influence in relation to SM. The final section provided information on the personal experience with SM. In this study, the term scientific misconduct was used interchangeably with RM.

We used the modified tool adapted by Okonta and Rossouw (2013). The modifications in the tool included the definitions of falsification and plagiarism for clarity and a question asking about personal involvement in any misconduct. To these modifications, we added an item at the end of the tool to provide participants with an opportunity to give additional comments or feedback that the participants felt had not been covered in the tool.

The questionnaire was incorporated, as an online survey, on the REDCAP platform by a bioinformatician from the Institute of BioMedical Informatics (IBMI) at Moi University. At the opening page of the REDCAP survey, the potential participant was given brief information about the purpose of the survey and invited to decide if they wanted to participate in the survey or not. It was indicated that proceeding beyond the introductory information page constituted an interest in the survey and that they would be engaged in an informed consent process to participate. The participants were only able to access the first page of the survey after providing consent.

Sample size and participant recruitment

The calculated sample of 334 was based on an estimated prevalence of 68% for QRP in Africa (Okonta and Rossouw 2013) and utilizing the Cochran formula (Cochran 1977). In calculating the sample size, we set the precision of the estimate at 5% with a 95% confidence.

We applied and obtained an approval from NACOSTI and NACC to access the data from the *Maisha Maarifa* website. NACC provided a list of 783 researchers engaged in HIV-related research that had registered in the database. After a review of the list, we identified 667 potential participants. The 116 that were dropped were either duplicate records or did not have any contact information. We sent test text messages and e-mails to the 667 potential participants and confirmed that 90 of the contacts were invalid and were excluded from the study. The remaining 577 thus became the study population from which the survey sample was obtained.

Pilot testing the data tool

We pilot tested the REDCAP platform survey by requesting the participation of eight non-HIV research participants at Moi University School of Medicine with a view to gaining insight into the feasibility of using the survey tool on an online platform. Some parameters assessed during the pilot test included: how long the survey would take, the response rate, and any other implementation relevant issues. The pilot study found a low response rate of 37.5%. This necessitated a reconsideration of strategies to improve the response rate by sending prospective participants a text message alerting them about the invitation to participate and informing them of the duration of the survey. Additionally, due to the low response, we applied to the Moi REC for an amendment to allow for a census sample (i.e., approaching all 577 potential participants) to be carried out in the hope that this would allow the study reach a sample equivalent to the original calculated sample of 334.

Data collection

Based on lessons learned from the piloting of the data tool, we sent text messages to the phones of all potential participants in the census survey informing them of impending posting of the link to the survey document on their e-mails. Further, we informed them that they would be offered informed consent before proceeding to access the survey itself and that those proceeding to the survey would be deemed to have consented to participate in the survey. The link to the survey was then posted within 24 hours of the text alert. The first part of the survey was the consent process, and the respondents only proceeded to the actual survey if they provided consent to do so. The survey consisted of six parts dealing with the salient thematic issues including participant demographics and role in HIV research in the past 5 years, definition of RM, perceptions on occurrence of misconduct by known colleagues and by self, perceptions on institutional readiness to identify and address RM, and perceptions on the relative effectiveness of the institutional capacities for managing RM including perceptions on the

sanctions and punishments of the perpetrators of RM embedded in the institutional regulations.

Data management and analysis

The REDCAP platform for the online survey had been configured to facilitate data summarization and avail the quantitative data in a format that allowed export to other software for data analysis. For this paper, the data analysis was carried out using SPSS version 24 program. The variables of interest were the social and professional characteristics of respondents as well as past behavior and attitudes relevant to RM at the workplace.

We used descriptive statistics to highlight the estimated frequency of self-reported awareness of RM, ever-involvement in any RM including both FFP and QRPs, and the frequency of reports of ever-involvement in FFPs alone. Ever-involvement was defined as *participating in any act of RM at any time in their career up to the time of the online survey.*

For this paper, the questions analyzed, excluding the demographics, are presented in Box 1.

We applied bivariate analyses using the frequency of awareness of ever-involvement in any RM and ever-involvement in FFPs as separate dependent variables. Participant characteristics including own research-related experience as well as perceptions on institutional capacity and rules and regulations

Domain Analyzed	Question
Awareness of RM	In your work place, how often have you been aware that an investigator engaged in scientific misconduct during the past 5 years?
Source of information leading to awareness	How did you learn about the instances of scientific misconduct you are aware of?
Ever involvement in FFPs and QRP	Have you ever been involved in: FFPs Plagiarism (Presenting others' work as own) Falsifying (changing or omitting) data Fabricating (constructing and/or adding) data QRPs Intentional protocol violations related to subject enrolment Intentional protocol violations related to procedures Selective dropping of data from 'outlier' cases Falsification of biosketch, resume, reference list Disagreements about authorship Pressure from study sponsor (eg pharmaceutical company or device company) to engage in unethical practices?

Box 1. Salient questions analyzed.

were included in the bivariate analysis models as independent variables, and *p*-values based on Chi-Square and Fisher's exact statistics, where cells had counts less than 5, were calculated. In this paper, we were unable to run meaningful multivariate analyses due to the relatively small numbers occasioned by the low response rate, and we were consequently unable to make conclusions on predictors. We, however, identified significant associations or correlates using the bivariate analysis. Correlates that had *p*-values less than 0.05 on bivariate analyses are summarized in the narrative for the results, while those that were not significant are only shown in the relevant tables.

Ethical considerations

The research was submitted for ethics review and received an approval from Moi University/Moi Teaching and Referral Hospital Institutional Research Ethics Committee (Moi IREC). The proposed amendment to the initial calculated sample size after the pilot study was also presented for ethics review and approval before being implemented. Furthermore, we obtained approval from the original developer of the SMQ-R tool to adapt the tool for our study. To gain access to the *Maisha Maarifa* database, we obtained authorization from NACOSTI and NACC. Lastly, all participants provided an online written informed consent before proceeding to the survey.

Results

We present data from a Scientific Misconduct Questionnaire-Revised (SMQ-R) online survey on a REDCAP platform involving researchers in Kenya who had an approved HIV research proposal in the 5 years preceding the survey. Out of 873 researchers listed in the database at the time, 667 were eligible and had valid contact; 667 e-mails were sent and 577 delivered; of which 100 provided a consent to participate and proceeded to respond to at least one of the questions in the survey (see flow chart – Figure 1). The response rate was low at 17.3%. The numbers (Ns) vary between 81 and 89 depending on participants who provided responses to the specific survey question analyzed in this report. In each table, we provide the numbers that responded to the question as N.

Females accounted for 52% of the respondents that provided adequate responses. The commonest workplaces were academic institutions (30.9%), public hospitals (29.9%), and research centers (14.4%). It is likely that those attached to academic institutions were the same as those attached to a public hospital since most tertiary institutions were either medical schools or medical training colleges which normally use a public hospital as the teaching hospital. As for the positions held, similar numbers indicated that they were clinicians (28.6%), lecturer (22.4%), and researchers (23.5%). Again, this distribution of position held reflects the triple mission of most institutions

of higher education where the faculty staffs are lecturer, carry out research, and provide extension services (in this case, clinical services). Quite often, faculty staffs are health professionals before being recruited into the academia and hence the slightly higher number indicating that they were holding clinician positions. The respondents included research managers and other positions because they were listed in the database as researchers on their own rights. The respondents reported having been involved in research for a median duration of 5 years interquartile range (IQR) (: 3–10 years) and having a median of two publications (IQR: 1–5.75). More details on demographics and professional characteristics are provided in Table 1.

Self-reported awareness of RM and sources of information

We asked the respondents: "In your work place, how often have you been aware that an investigator engaged in scientific misconduct during the past 5 years?" The responses were dichotomized to never or at least once. Since the question did not specify who was observed to have committed the misconduct, it is assumed that the respondents were reporting on misconduct observed and misconduct committed by self. Out of 89 respondents, 48 (53.9%) were aware of one or more incidents of RM *over the past 5 years*. We specified awareness over the past 5 years as a duration compatible with acceptably low frequency of recall bias. Five years was also considered a long enough period during which there was a likelihood of having observed an incident of RM, itself being a fairly infrequent event.

To assess the sources of information/awareness, we asked: "How did you learn about the instances of scientific misconduct you are aware of?" Personal observation and other researchers were the most commonly reported sources

Table 1. Participant demographic and professional characteristics.

	Category	Number (%)
Sex (n = 98)	Female	51 (52)
	Male	47 (48)
Primary place of work (n = 97)	Academic institution	30 (30.9)
	Ministry	4 (4.1)
	Private hospital	7 (7.2)
	Public hospital	29 (29.9)
	Research center	14 (14.4)
	Others[a]	13 (13.4)
Position (n = 98)	Administrator	7 (7.1)
	Clinician	28 (28.6)
	Lecturer	22 (22.4)
	Researcher	23 (23.5)
	Other[b]	18 (18.4)

[a]Other places of work included reference laboratory = 2, NGO = 6, pharmacy = 1, student = 1, for-profit company = 1, freelance = 1, and Ministry of Public Service, Youth and Gender Affairs = 1.

[b]Other positions included youth officer = 1, manager/chief executive = 4, medical laboratory officer = 1, student = 3, tutorial fellow/part timer = 2, pharmacist = 1, public health officer = 2, technical advisor = 2, study Coordinator = 1.

Table 2a. Frequency of self-reported awareness of RM and sources of information.

Awareness (N = 89)	Proportion, n (%)	Sources of information	%
No	41 (46.1)	N/A	N/A
Yes	**48 (53.9)**	Personal observation	66.7
		Other researchers	62.5
		Official institutional channels	33.3
		Study monitors	33.3
		Institutional ethics committees	25.0
		Others[a]	14.6

[a]Discussing with the investigators/researchers themselves, 2; informed by a previous interviewee, 1; media, 2.

of information associated with the awareness of RM. Institutional mechanisms, study monitors, and ethics committees were also mentioned as the source of the awareness of RM. Table 2a shows the self-reported awareness and sources of information leading to the awareness.

Occurrence of ever-involvement in RM

Using the SMQ-R tool, we asked respondents about their personal involvement in RM during their careers. Specifically, we asked: "Have you ever been involved in … (see Box 1)." We used the word "involved" due to the collaborative nature of most health research. The possible options for responses included FFP and elements of QRP. The FFPs had definitions appended for clarity and uniformity of interpretation since this was an online self-administered survey.

Table 2b presents frequencies of ever-involvement in specific behaviors that comprise RM (FFP and QRPs). Ever-involvement connoted participation as a researcher (in any role, for example, as principal investigator, investigator, or coordinator) in any past study where acts of RM occurred during their career up to the time of the survey. Since RM isa relatively uncommon event, we asked about such behaviour over the respondent's entire research career, hence ever-involvement in RM. Ever-involvement in individual acts constituting FFP was common: fabrication 24%, falsification 22%, and plagiarism 22%. The

Table 2b. Occurrence of ever-involvement in specific acts of RM.

	Frequency (%)	
Form of RM	Never	Yes
Plagiarism (n = 82)	64 (78)	18 (22)
Falsifying data (n = 82)	64 (78)	18 (22)
Fabricating data (n = 81)	62 (76.5)	19 (23.5)
Intentional protocol violation, enrollment (n = 82)	65 (79.3)	17 (20.7)
Intentional protocol violation, procedure (n = 82)	64 (78)	18 (22)
Selective dropping of outlier data (n = 82)	55 (67.1)	27 (32.9)
Biosketch, resume, reference list falsification (n = 81)	72 (88.9)	9 (11.1)
Disagreements about authorship (n = 82)	56 (68.3)	26 (31.7)
Sponsor pressure to do unethical acts (n = 81)	70 (86.4)	11 (13.6)

commonest acts considered QRP were selective dropping of outlier data 33% and authorship disputes 33%.

To generate a composite estimate of ever-involvement in RM, we derived the proportion of respondents that had ever-involved in at least one act that constitutes RM. For this analysis, we combined the responses on FFP and QRP to connote the broad definition of any RM. Of 82 respondents, 56 (68.3%) reported *ever-involvement* involved in any RM (either FFPs or QRPs). We also analyzed for ever-involvement in FFPs alone, excluding QRPs. Of 81 respondents who addressed the question on RM involvement, 29 (35.8%) reported *ever-involvement* in any FFP.

Correlates of awareness of RM

Awareness of RM was associated with the position held by the respondent ($p = 0.015$) with lecturers being more likely to report awareness; perceptions on the severity of penalties if caught ($p = 0.006$); perceptions on the likelihood of being caught if involved in RM ($p = 0.003$); respondent's self-reported support for the rules and regulations on RM ($p = 0.005$); and perceptions on the effectiveness of the institutions' rules and procedures for managing RM ($p < 0.0001$) – Table 3. These findings are consistent with the likelihood of the availability of clear rules and regulations in academic institutions compared to other work environments. Such rules and regulations would conceivably be known to lecturers who are normally responsible for the training of students/entry-level researchers in research methods and the governance of research practice that includes management of RM. The more effective and strict the rules and regulations are perceived to be, the stiffer the penalties for contravention and the higher the likelihood of institutional efforts to create awareness among stakeholders. This explains the associations observed.

Among the participant variables assessed for correlation (Table 4) with a self-report of *ever-involvement* in any RM, researcher understanding of rules and procedures related to RM and researcher support of rules and procedures related to RM were significantly associated with report of ever-involvement in any RM, $p = 0.006$ and $p = 0.046$, respectively. Most of the individual and institutional factors tested for association were not significantly associated with self-reports of past RM. The survey asked for ever-involvement in any RM, implying that the RM referred to could have been committed much before being aware of the rules and regulations. If this is the case, then understanding and supporting the institutional rules and regulations in RM could have associated with self-report of earlier RM. Such admission to involvement in RM could be part of the realization of the significance of the past misbehavior and also a perception of reduced potential for the consequences of such past behavior.

Table 3. Correlates of awareness of RM.

		Never (%)	Once or more times (%)	Test statistic
Gender (n = 87)	Female	18 (42.9)	24 (57.1)	Chi-Square p
	Male	22 (48.9)	23 (51.1)	value = 0.57
Number of years involved in research (n = 89)	Below 5	19 (57.6)	14 (42.4)	Chi-Square p
	5 and above	22 (39.3)	34 (60.7)	value = 0.095
Number of publications (n = 87)	Below 5	29 (47.5)	32 (52.5)	Chi-Square p
	5 and above	11 (42.3)	15 (57.7)	value = 0.65
Primary place of work (n = 87)	Academic institution	10 (34.5)	19 (65.5)	Chi-Square p value = 0.08
	MOH	12 (42.9)	16 (57.1)	
	Research Institution	10 (76.9)	3 (23.1)	
	Others	8 (47.1)	9 (52.9)	
Position held (n = 87)	Clinician	17 (65.4)	9 (34.6)	Chi-Square p
	Lecturer	7 (35)	13 (65)	value = **0.016**
	Researcher	12 (54.5)	10 (45.5)	
	Others	4 (21.1)	15 (78.9)	
Attended training on ethics before (n = 89)	No	7 (63.6)	4 (36.4)	Chi-Square p
	Yes	34 (43.6)	44 (56.4)	value = 0.21
Severity of penalties for SM (n = 88)	Low	2 2(36.7)	38 (63.3)	Chi-Square p
	High	19 (67.9)	9 (32.1)	value = **0.006**
Chances of getting caught for SM if it occurs (***n*** = 89)	Low	21 (35)	39 (65)	Chi-Square p
	High	20 (69)	9 (31)	value = **0.003**
Researchers' understanding of rules and procedures related to SM (n = 89)	Low	12 (36.4)	21 (63.6)	Chi-Square p
	High	29 (51.8)	27 (48.2)	value = 0.16
Your own understanding of rules and procedures related to SM (n = 89)	Low	5 (55.6)	4 (44.4)	Fisher's exact 0p
	High	36 (45)	44 (55)	value = 0.73
Researchers' support of rules and procedures related to SM (***n*** = 88)	Low	9 (27.3)	24 (72.7)	Chi-Square p
	High	32 (58.2)	23 (41.8)	value = **0.005**
The effectiveness of your institution's rules and procedures for reducing SM (***n*** = 88)	Low	13 (28.3)	33 (71.7)	Chi-Square p
	High	28 (66.7)	14 (33.3)	value = **<0.0001**

A report of *ever-involvement* in FFP was significantly associated with number of years involved in research (p = 0.041), perceptions on chances of getting caught for RM if it occurs (p = 0.004), and researcher support of rules and procedures related to RM (p = 0.023) – Table 5.

We also interpret the findings of significant association with researcher support of rules and regulations and perceptions on chances of getting caught in the same way as those given in Table 4 since ever-involvement in FFP is actually a subset of ever-involvement in any RM (including FFPs and QRPs). Chances of getting caught are a reflection of perceptions on the effectiveness of the rules and regulations and the governance systems for RM. Again, since FFPs are considered fraud and the most serious misbehavior, we posit that the association with number of years in research may be a reflection of the research experience of the respondent and the possible (perhaps incorrect) confidence that the past involvement in FFP though serious is unlikely to affect their current position.

Table 4. Correlates of self-reported ever-involvement in any RM (FFP and QRPs).

		Never (%)	Once or more times (%)	Test statistic
Gender (n = 79)	Female	13 (31.7)	28 (68.3)	Chi-Square p
	Male	12 (31.6)	26 (68.4)	value = 0.99
Number of years involved in research (n = 80)	Below 5	9 (30)	21 (70)	Chi-Square p
	5 and above	17 (33.3)	34 (66.7)	value = 0.76
Number of publications (n = 80)	Below 5	20 (35.7)	36 (64.3)	Chi-Square p
	5 and above	5 (20.8)	19 (79.2)	value = 0.19
Primary place of work (n = 79)	Academic institution	8 (30.8)	18 (69.2)	Chi-Square p value = 0.84
	MOH	7 (28)	18 (72)	
	Research Institution	5 (38.5)	8 (61.5)	
	Others	6 (40)	9 (60)	
Position held (n = 79)	Clinician	9 (39.1)	14 (60.9)	Chi-Square p
	Lecturer	5 (27.8)	13 (72.2)	value = 0.78
	Researcher	6(27.3)	16 (72.7)	
	Others	6 (37.5)	10 (62.5)	
Attended training on ethics before (n = 81)	No	2 (20)	8 (80)	Fisher's exact p
	Yes	24 (33.8)	47 (66.2)	value = 0.49
Severity of penalties for SM (n = 80)	Low	15 (28.3)	38 (71.1)	Chi-Square p
	High	11 (40.7)	16 (59.3)	value = 0.26
Chances of getting caught for SM if it occurs (n = 81)	Low	15 (28.3)	38 (71.7)	Chi-Square p
	High	11 (39.3)	17 (60.7)	value = 0.31
Researchers' understanding of rules and procedures related to SM (***n*** = 81)	Low	4 (13.3)	26 (86.7)	Fisher's exact p
	High	22 (43.1)	29 (56.9)	value = **0.006**
Your own understanding of rules and procedures related to SM (n = 81)	Low	1 (12.5)	7 (87.5)	Fisher's exact p
	High	25 (34.2)	48 (65.8)	value = 0.43
Researchers' support of rules and procedures related to SM (***n*** = 80)	Low	6 (19.4)	25 (80.6)	Chi-Square p
	High	20 (40.8)	30 (59.2)	value = **0.046**
The effectiveness of your institution's rules and procedures for reducing SM (n = 80)	Low	9 (22.5)	31 (77.5)	Chi-Square p
	High	17 (42.5)	23 (57.5)	value = 0.056

Discussion

In this online survey of 89 HIV researchers in Kenya, we recorded a 53.9% awareness rate of occurrence of RM in the *5 years preceding the survey*. For the purpose of this study, the terms scientific misconduct and RM were used interchangeably. This reported rate of awareness was similar to from Nigeria (Okonta and Rossouw 2014) that reported 50% of researchers were aware of a colleague having committed RM in Nigeria. Personal observations as well as information from other researchers were the most commonly reported sources of information leading to awareness of RM. Institutional structures such as ethics committees and study monitors were similarly significant sources of information. Awareness of RM was associated with being a worker in an academic institution. Further, awareness was associated with perceptions of the existence of strong institutional frameworks and policies for managing and sanctioning RM offenders. Taken together, these findings suggest that investment in researcher training in responsible conduct of research as well as setting up of strong and well-disseminated

Table 5. Correlates of ever-involvement in FFPs.

		Never (%)	Once or more times (%)	Test statistic
Gender (n = 79)	Female	26 (63.4)	15 (36.6)	Chi-Square p
	Male	24 (63.2)	14 (36.8)	value = 0.98
Number of years involved in research (***n*** = 81)	Below 5	15 (50)	15 (50)	Chi-Square p
	5 and above	37 (72.5)	14 (27.5)	value = **0.041**
Number of publications (n = 80)	Below 5	33 (58.9)	23 (41.1)	Chi-Square p
	5 and above	18 (75)	6 (25)	value = 0.171
Primary place of work (n = 79)	Academic institution	16 (61.5)	10 (38.5)	Fisher's exact p value = 0.78
	MOH	17 (68)	8 (32)	
	Research institution	10 (76.9)	3 (23.1)	
	Others	9 (60)	6 (40)	
Position held (n = 79)	Clinician	14 (60.9)	9 (39.1)	Chi-Square p
	Lecturer	12 (66.7)	6 (33.3)	value = 0.825
	Researcher	14 (63.6)	8 (36.4)	
	Others	12 (75)	4 (25)	
Attended training on ethics before (n = 81)	No	7 (70)	3 (30)	Fisher's exact
	Yes	45 (63.4)	26 (36.6)	p value = 0.683
Severity of penalties for SM (n = 80)	Low	32 (60.4)	21 (39.6)	Chi-Square p
	High	19 (704)	8 (29.6)	value = 0.379
Chances of getting caught for SM if it occurs (n = 81)	Low	28 (52.8)	25 (47.2)	Chi-Square p
	High	24 (85.7)	4 (14.3)	value = **0.004**
Researchers' understanding of rules and procedures related to SM (n = 81)	Low	20 (64.5)	11 (35.5)	Chi-Square p
	High	32 (64)	18 (36)	value = 0.96
Your own understanding of rules and procedures related to SM (n = 81)	Low	5 (62.5)	3 (37.5)	Fisher's exact p
	High	47 (64.4)	26 (35.6)	value = 0.92
Researchers support of rules and procedures related to SM (n = 80)	Low	15 (48.4)	16 (51.6)	Chi-Square p
	High	36 (73.5)	13 (26.5)	value = **0.023**
The effectiveness of your institution's rules and procedures for reducing SM (n = 80)	Low	22 (55)	18 (45)	Chi-Square p
	High	29 (72.5)	11 (27.5)	value = 0.104

relevant institutional frameworks may have a significant impact on identifying cases of RM within an institution.

In this survey, we used a broad definition of RM that included FFPs and also any other QRPs (Awais and Awais 2014) (Gupta 2013). Over 68% of respondents reported *ever-involvement* in at least one behavior considered to be an RM (defined broadly as FFPs and/or QRPs). A higher proportion reported *ever-involvement* in RM than reported awareness about RM in the *5 years preceding the survey*. This curious finding is likely explained by the fact that awareness was restricted to the preceding 5 years, while ever-involvement was over the entire research career of the respondent. . We restricted the awareness to 5 years to reduce recall bias. Our findings are a near replica of the findings from Nigeria (Okonta and Rossouw 2013) surveying selected researchers in Nigeria who also reported 68.9%. A recent study from the Middle East has documented that 59.4% of respondents reported at least one RM (Felaefel et al. 2018). Our findings suggest that RM is not uncommon in the Kenyan HIV research environment.

FFPs are considered the worst forms of RM equated to fraud and outright cheating. They account for a significant proportion of retractions of articles from peer-reviewed journals (Fang, Grant Steen, and Casadevall 2012). Our survey tool asked specific questions on ever-involvement in behaviors amounting to FFPs and QRPs separately. A high proportion of 36% reported that they had been involved in commission of at least one of the FFPs in their research work. Slightly over one in five respondents reported ever-involvement in falsification or plagiarism individually and nearly a quarter reported ever-involvement in fabrication of data. Among the QRPs, the selective dropping of outlier data and authorship disputes were the most common misbehaviors reported by up to one-third of respondents. In Nigeria, 42.2% of researchers admitted to committing acts of falsification of data and plagiarism (Okonta and Rossouw 2013). The study of Nigerian researchers also reported that authorship disputes were committed by 36.4%, a finding quite comparable to our finding of 32%. In our study, the selective dropping of data points as a form of QRP was reported by 33%. The reports of commission of individual FFPs by between 22% and 24% of respondents are higher than the reports on RM in the high-income countries that documented self-reports of nearly 2% for FFPs. However, the self-reported commission of individual QRPs fell within the range of 33.7% of researchers who admitted to committing QRPs in the systematic review (Fanelli 2009). Our study asked for self-reports on FFP, while the systematic review restricted its analysis to fabrication and falsification. It is possible that the inclusion of plagiarism in our study accounts for part of the large excess of reports on FFP compared to the systematic review findings. In the high-income countries especially the United States, the definition of RM focusses on FFPs. It is also conceivable that the strong institutional research oversight as well as training and mentorship programs in the high-income countries, especially the United States of America, may have had the desired deterrent effect leading to lower frequencies of report of involvement in fabrication and falsification while not impacting commission of QRPs as much. Correlates of self-reports of ever-involvement in FFPs included number of years in research, research support for the rules and regulations on RM, and perceptions on the chances of getting caught if RM is perpetrated. Studies in the United States (Pryor, Habermann, and Broome 2007) and in Nigeria (Okonta and Rossouw 2014) have reported similar findings suggesting that perceptions on the institutional regulatory environment are associated with the likelihood of reporting knowledge of RM.

Our study had several limitations. First, it was a survey based on self-reports of potentially incriminating and stigmatizing academic behavior. It is likely that respondents would have minimized self-reports of their own perpetrations. Previous studies have identified this methodological weakness (Fanelli 2009). Therefore, our reports could be underestimates and

which points to a large problem in our setting given the already high proportions of self-reported FFPs and QRPs. Second, our study was substantially compromised by a low response rate compared to the projected representative sample size, and this reduced the robustness and precision of our data. Due to the small sample, we were unable to identify predictors of occurrence of RM. Consequently, we were only able to report correlates based on bivariate analyses. We rather unsuccessfully attempted to mitigate the low response rate by increasing the sample size to a census survey, alerting potential study participants by text before sending the survey, and sending three reminders to participants to complete the survey.

Nonetheless, our study had one major strength in using a validated study tool, the SMQ tool (Broome et al. 2005). A modification of this tool (SMQ-R) has been used by a study in Nigeria (Okonta and Rossouw 2013) and offered an opportunity to compare our findings with those from Nigeria and thereby beginning to add to the body of estimates of the prevalence of RM in the African setting. Our findings on awareness and occurrence of RM were comparable to those from Nigeria confirming that RM is indeed not uncommon in Africa.

In conclusion, our study, though from a small sample, found that awareness of RM was reported by over half of HIV researchers in Kenya completing our online survey. Our study also reveals rather high rates of self-reported involvement in RM. The awareness of RM was associated with the position held by the respondent and perceptions on and beliefs about the existence and effectiveness of institutional structures for managing RM. Self-reports of involvement in RM were related to reports of understanding and support of institutional rules and procedures on RM. Self-report of FFPs was associated with number of years in research position as well as perceptions on and support for the rules and procedures on managing RM.

We recommend that academic and research institutions develop and disseminate widely their policies and regulations guiding RM and related sanctions as a preliminary step to addressing the challenge of RM. Programs to deliberately train researchers in responsible conduct of research are also needed.

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Disclosure statement

The authors declare that they have no competing interests.

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Authors' Contribution

This study was designed by EW and JK. EW drafted the first draft; EK cleaned and analyzed the data. EW, JK, and EK made revisions on the drafts. All authors read and approved the final draft of the manuscript.

Data Availability

All relevant data are within the paper and supporting information files.

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