



## Research Ethics Education among Graduate Students of the University of Ibadan, Southwest Nigeria

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Authors KOO and TOO designed the study. Author KOO collected the data, performed the statistical analysis and wrote the first draft of the manuscript. All authors read and approved the final manuscript.*

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### ABSTRACT

**Aims:** Research ethics is an integral part of graduate education in developed countries; but little is known about exposure of graduate students in Nigeria to this subject. This study aimed to document the current teaching and knowledge of research ethics among graduate students of the University of Ibadan, Nigeria.

**Study Design:** A cross-sectional, exploratory study.

**Place and Duration of Study:** Four faculties (Basic Medical Sciences, Clinical Sciences, Dentistry and Public Health) of the College of Medicine, University of Ibadan, southwest Nigeria in July 2010.

**Methodology:** We interviewed 250 graduate students (40.4% males and 59.6% females) using a 55-item self-administered questionnaire to obtain data on general information and socio-demographic characteristics of the participants; research work during graduate students' programme; knowledge of research ethics, research integrity and research misconduct; perception and practice of research ethics; and research ethics training needs.

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**Results:** The mean age of study participants was 31.5±7.1 years; 82% received training on research ethics in current graduate work. 65.2% demonstrated good knowledge for research ethics and research misconduct separately and 51.2% for research integrity. Overall mean knowledge scores were 3.1±1.6 for research ethics, 2.5±2.0 for research integrity and 5.3±1.9 for research misconduct. Age and faculty location were predictors of knowledge of research integrity and research misconduct respectively.

**Conclusion:** It is desirable to integrate the existing structure of research ethics education. Expanding the scope of human development unit of tertiary institutions of learning to include capacity building and community engagement activities on research ethics for graduate students is suggested.

*Keywords: Research ethics; graduate students; knowledge; training; Nigeria.*

## 1. INTRODUCTION

More than ever before, researchers have become sensitive to the ethics of research. The expanding scope of research ethics has sensitized the society, which has become conscious of the necessity of getting involved in decision-making on issues or procedures which ultimately affect their health, wellbeing and liberty. Likewise, the use of animals in biomedical research has generated contentious issues in the society; this is because public attention to animal experimentation has placed researchers at the centre of controversy over animal consciousness and pain, the meaning of suffering, and the roles of animals in human life. Consequently, it has been suggested that researchers working with human participants and animals must be familiar with, and adhere to the regulatory guidelines and procedures governing their work and understand the origins and purpose of these regulations [1].

Evidence abounds that research ethics have impacted positively in protecting the integrity of participants involved in public health research and practice [2]. This is because the knowledge and utilization of bioethical principles have contributed, in part, to improvements in the conduct of research and reduction in the prevalence of scandals of the form and magnitude of those already recorded in the history of biomedical research compared to the volume of research being conducted at this time.

From the foregoing, the importance of research ethics cannot be underscored. However, the hitherto indirect method of imbibing ethical values through on-the-job training is no longer sufficient to equip researchers in meeting the ethical challenges of modern day biomedical research and practice. Thus, the need for formal education in research was thus acknowledged. In the developed world, education in ethics is no longer a “hidden curriculum” [3]. It has been reported that universities can no longer rely only on the traditional apprenticeship system and role modeling to transmit standards of scientific integrity to trainees [4]. Therefore, research ethics education has become an “open” subject that is actively taught, not only in medical schools, but also in institutions involved in the training of other categories of health care workers in the developed world. It has also become a required course in the training of graduate students involved in human subject and laboratory animal research in most countries where bioethics is well grounded [5].

While training in research ethics has become a vital component of graduate education in developed countries [6,7], this is not the case in Nigeria. Therefore, this study was designed to document the current teaching, exposure and knowledge of research ethics among graduate students of a Nigerian university. The information obtained was useful in

suggesting appropriate short and long-term policy measures required to fill the existing gaps and integrate formal bioethics teaching into educational system at graduate level.

## **2. MATERIALS AND METHODS**

A descriptive cross-sectional study with an exploratory component was carried out among graduate students of the four Faculties (Basic Medical Sciences, Clinical Sciences, Dentistry and Public Health) of the College of Medicine, University of Ibadan in southwestern part of Nigeria in July 2010 - one month to the end of 2009/2010 academic session. This study was part of a large survey titled "*Research and Medical ethics education among postgraduate students and medical undergraduates in Nigeria*" and for which an ethical approval was previously obtained by the Principal Investigator from the University of Ibadan/University College Hospital (UI/UCH) Ethical Committee. A 55-item pre-tested self-administered questionnaire was developed and used to obtain data on general information and socio-demographic characteristics of the participants; research work during graduate students' programme; knowledge of research ethics, research integrity and research misconduct; perception and practice of research ethics; and research ethics training needs.

Study participants were recruited at the end of any departmental academic forum such as a joint class, seminar and meeting in their respective departments; prior permission of the teacher or chair of such academic sessions to interview students was obtained. In addition, the teacher or chair also helped introduce the research to the students and sought their cooperation; all these efforts assisted in getting a high response rate. The attendance list of the respective academic forum was used as a sampling frame and an appropriate sampling fraction was estimated for each group of study participants. Afterwards, participants were recruited into the study using the systematic random sampling technique. A detailed explanation of the study protocol was provided to each of the selected students and a written consent obtained from the participants, who agreed to participate in the study. Each consenting participant was given a copy of the questionnaire to complete by self voluntarily and clarifications were provided for those who sought. Participants' attention was particularly drawn to the sections of the questionnaire which involved skipping and respondents were promptly referred to these sections for necessary correction whenever inconsistency was observed.

### **2.1 Data Management**

Data analysis was done with Stata Statistical Software: Release 10. College Station, Texas 77845 USA. Knowledge of each participant on the studied variables was assessed using a list of information items with respect to each variable; thus, research ethics had a list of 5 information items, research integrity - 5 items and research misconduct - 7 items. Each participant was scored based on the number of items answered correctly. If none of the items was answered correctly, the participant was scored 0 for the variable. Consequently, knowledge scores were computed for each respondent with respect to knowledge items which ranged as follows: research ethics ranged from 0 to 5, research integrity ranged from 0 to 5 and research misconduct ranged from 0 to 7. Each respondent was categorized as having good or poor knowledge as follows: research ethics (knowledge score of  $\leq 2$  is poor;  $\geq 3$  is good); research integrity (knowledge score of  $\leq 2$  is poor;  $\geq 3$  is good); research misconduct (knowledge score of  $\leq 3$  is poor;  $\geq 4$  is good). Descriptive statistics such as proportions, means and standard deviations were used to summarize socio-demographic characteristics such as age, sex, level of study, type of programme, faculty location and year

of programme. Chi-square test was used to explore association between these variables estimated in proportions while comparisons of means between dependent and independent variables were explored using Students' t-test. The results of association which were significantly different between the respondents were the ones regressed to adjust for socio-demographic variables in a multiple logistic regression; p-level was set at 5%.

### 3. RESULTS

#### 3.1 Socio-Demographic Characteristics of Respondents

A total of 268 graduate students were recruited and given questionnaire to complete; however, 250 participated giving a response rate of 93.3%. The ages of the study participants ranged from 22 to 60 years with a mean of  $31.5 \pm 7.1$  years. Most of the participants, 149 (59.6%) were females and majority, 206 (82.4%) were undertaking a Master's degree programme Table 1. Majority (187/74.8%) of the respondents were in their first year of graduate studies while 40 (16.0%) were in their second year. More than half of the respondents (133/53.2%) were graduate students in the Faculty of Public Health while one-third of the remaining students were in the Faculty of Basic Medical Sciences. Table 1 also shows the specialty areas of the graduate students with about 25% belonging to the Department of Epidemiology, Medical Statistics and Environmental Health.

**Table 1. Socio-demographic characteristics of respondents (N = 250)**

<b>Characteristics</b>	<b>No.</b>	<b>(%)</b>
<b>Sex</b>		
Male	101	(40.4)
Female	149	(59.6)
<b>Type of Postgraduate programme</b>		
Masters	206	(82.4)
MPhil/PhD	44	(17.6)
<b>Faculty</b>		
Basic Medical Sciences	79	(31.6)
Clinical Sciences	30	(12.0)
Dentistry	8	(3.2)
Public Health	133	(53.2)
<b>Year of study</b>		
1st Year	187	(74.8)
2nd Year	40	(16.0)
≥ 3rd Year	23	(9.2)

#### 3.2 Previous and Current Research Work in Respondents' Programme

Two hundred and thirty five (94.0%) reportedly carried out research as part of their undergraduate work Table 2. Of these, 100 (42.5%) had previously received research ethics training for undergraduate work; among whom the training was considered at least adequate for conducting research responsibly in 63 (60.1%). With respect to the research component of their current graduate programme, about half of the respondents, 117 (46.8%) either anticipated using or were currently using descriptive cross-sectional study design; whereas, it was experimental in 88 (35.2%) and cohort retrospective in 20 (8.0%). The majority (195/78.0%) were at the stages of developing concepts and writing proposals for their

projects while 55 (22.0%) were at the later stages of their projects i.e. data collection and analysis, writing up thesis or dissertation and publication Table 2.

**Table 2. Previous and current research work in respondents' programmes (N = 250)**

<b>Characteristics</b>	<b>NO.</b>	<b>(%)</b>
<b>Undergraduate research experience</b>		
Yes	235	(94.0)
No	15	(6.0)
<b>Design of current research project</b>		
Cross sectional	117	(46.8)
Experimental	88	(35.2)
Cohort retrospective	20	(8.0)
Case control	19	(7.6)
Cohort longitudinal	6	(2.4)
<b>Stage of current research project</b>		
Developing concepts	85	(34.0)
Writing proposal	110	(44.0)
Data collection	36	(14.4)
Data analysis	11	(4.4)
Writing of thesis/ dissertation	5	(2.0)
Publication	3	(1.2)

### **3.3 Knowledge of Research Ethics, Research Integrity and Research Misconduct**

#### **3.3.1 Research ethics**

Among the respondents, 94% have heard about research ethics and majority (163/65.2%) had a good knowledge (i.e. score of  $\geq 3$ ) of it. Respondents' overall mean knowledge score of research ethics was  $3.1 \pm 1.6$  (range 0 to 5). The score was slightly higher among males,  $3.3 \pm 1.5$  than among females,  $3.0 \pm 1.6$  ( $t=1.5639$ ,  $P=.12$ ; 95% CI=2.7363-3.6047) Table 3. The mean knowledge score was  $3.2 \pm 1.5$  among respondents in a Master's degree programme compared to  $2.8 \pm 1.6$  for those in MPhil/PhD programme ( $t=1.6315$ ,  $P=.10$ ; CI=2.2783-3.4057) Table 3. Respondents in the Faculty of Public Health had the highest mean knowledge score,  $3.3 \pm 1.5$ ; followed by respondents in the Faculty of Clinical Sciences,  $3.1 \pm 1.8$  Table 3. The mean knowledge score among respondents in the Faculty of Public Health was significantly higher than those in the Faculties of Basic Medical Sciences ( $2.9 \pm 1.5$ ;  $P=.04$ ) and Dentistry ( $2.0 \pm 0.9$ ;  $P=.02$ ). After adjusting for other socio-economic variables, the type of postgraduate programme being undertaken by a study participant is not associated with knowledge of research ethics Table 4.

#### **3.3.2 Research integrity**

Among the respondents, 74% have heard about research integrity and about half (128/51.2%) had a good knowledge (i.e. score of  $\geq 3$ ) of it. Respondents' overall mean  $\pm$  SD knowledge of research integrity was  $2.5 \pm 2.0$  (range 0 to 5). The mean knowledge score was  $2.7 \pm 2.1$  among male respondents compared to  $2.5 \pm 2.0$  among females ( $t=0.8639$ ,  $P=.39$ ; 95% CI=2.1296-3.0906) Table 3. Similarly, the mean knowledge score was  $2.6 \pm 2.0$  among respondents on a Master's degree programme compared to  $2.4 \pm 2.2$  among those on MPhil/PhD programme ( $t=0.4979$ ,  $P=.62$ ; 95% CI=1.7394-2.8528); but these were not

significantly different Table 3. Respondents in the Faculty of Public Health had the highest mean knowledge score of research integrity,  $3.1 \pm 1.8$ ; followed by respondents in the Faculty of Clinical Sciences,  $3.0 \pm 2.1$  Table 3. The mean knowledge scores of research integrity among respondents in the Faculties of Public Health and Clinical Sciences were significantly higher than those in the Faculties of Basic Medical Sciences ( $1.5 \pm 1.9$ ;  $P < .001$ ) and Dentistry ( $1.2 \pm 1.6$ ;  $P = .01$ ). Younger respondents ( $< 30$  years) were about twice less likely to have good knowledge than older respondents ( $> 30$  years) ( $OR = 0.49$ ,  $95\% CI = 0.27-0.89$ ) Table 5.

**Table 3. Mean knowledge scores on research ethics (RE), research integrity (RI) and research misconduct (RM) by sex, type of postgraduate programme and faculty of respondents**

Characteristics	Research ethics issues		
	RE	RI	RM
<b>Sex</b>			
Male	$3.3 \pm 1.5$	$2.7 \pm 2.1$	$5.2 \pm 2.0$
Female	$3.0 \pm 1.6$	$2.5 \pm 2.0$	$5.4 \pm 1.8$
	$P = .12$	$P = .39$	$P = .60$
<b>Postgraduate Programme</b>			
Master	$3.2 \pm 1.5$	$2.6 \pm 2.0$	$5.5 \pm 1.8$
MPhil/PhD	$2.8 \pm 1.6$	$2.4 \pm 2.2$	$4.3 \pm 2.2$
	$P = .10$	$P = .62$	$P = .001$
<b>Faculty</b>			
Basic Medical Sciences	$2.9 \pm 1.5$	$1.5 \pm 1.9$	$4.2 \pm 2.2$
Clinical Sciences	$3.1 \pm 1.8$	$3.0 \pm 2.1$	$5.1 \pm 1.8$
Public Health	$3.3 \pm 1.5$	$3.1 \pm 1.8$	$5.8 \pm 1.6$
Dentistry	$2.0 \pm 0.9$	$1.2 \pm 1.6$	$4.2 \pm 2.4$
	$P = .03$	$P < .001$	$P < .001$

### 3.3.3 Research misconduct

Awareness of research misconduct among the respondents was 80.8% and 163 (65.2%) had a good knowledge (i.e. score of  $\geq 4$ ) of it. Their overall mean  $\pm$  SD knowledge score of research misconduct was  $5.3 \pm 1.9$  (range 0 to 7). The score was slightly higher among females,  $5.4 \pm 1.8$  than among males,  $5.2 \pm 2.0$  ( $t = -0.5210$ ,  $P = .60$ ;  $95\% CI = 5.0536-5.6935$ ) (Table 3). The mean knowledge score was  $5.5 \pm 1.8$  among respondents on a Master's degree programme compared to  $4.3 \pm 2.2$  for those on MPhil/PhD programme ( $t = 3.5249$ ,  $P = .001$ ;  $95\% CI = 3.5517-5.8028$ ) (Table 3). Respondents in the Faculty of Public Health had the highest mean knowledge score,  $5.8 \pm 1.6$ ; followed by respondents in the Faculty of Clinical Sciences,  $5.1 \pm 1.8$  (Table 3). The mean knowledge score among respondents in the Faculty of Public Health was significantly higher than those in the Faculties of Basic Medical Sciences ( $4.2 \pm 2.2$ ;  $P < .001$ ) and Dentistry ( $4.2 \pm 2.4$ ;  $p = 0.02$ ). The mean knowledge score among respondents in the Faculty of Clinical Sciences was significantly higher than those in the Faculty of Basic Medical Sciences ( $4.2 \pm 2.2$ ;  $P = .04$ ).

Respondents in the Faculty of Public Health were about three times more likely than those in Basic Medical Sciences to have good knowledge of research misconduct ( $OR = 2.96$ ,  $95\% CI = 1.08 - 8.06$ ) Table 6.

Table 4. Association between knowledge about research ethics and variables

Variable	Knowledge of research ethics				Multiple logistic regression		
	Good	Total	X <sup>2</sup>	P-value	Odds ratio (OR)	95% CI OR	P-value
<b>Age (Years)</b>							
<=30	89 (64.0)	139	0.189	.664			
>30	74 (66.7)	111					
<b>Sex</b>							
Male	68 (67.3)	101	0.338	.561			
Female	95 (63.8)	149					
<b>Postgraduate programme</b>							
Masters	140(68.0)	206	3.933	.047	1.49	0.71–3.14	.292
Mphil/PhD	23(52.3)	44			1		
<b>Type of programme</b>							
Academic	89(61.0)	146	7.471	.024	1		
Professional	62(76.5)	81			1.65	0.80–3.44	.178
Both	12(52.2)	23			0.62	0.24–1.60	.320
<b>Faculty</b>							
Public Health	95(71.4)	133	5.061	.080			
Basic Medical Sciences	47(59.5)	79					
Clinical Science and Dentistry	21(55.3)	38					

Table 5. Association between knowledge about research integrity and variables

Variable	Knowledge of Research integrity				Multiple logistic regression		
	Good	Total	X <sup>2</sup>	P - value	Odds ratio (OR)	95% CI OR	P - value
<b>Age (Years)</b>							
<=30	63(45.3)	139	4.327	.038	0.49	0.27–0.89	.019
>30	65(58.6)	111					
<b>Sex</b>							
Male	55(54.5)	101	0.719	.397			
Female	73(49.0)	149					
<b>Postgraduate programme</b>							
Masters	108(52.4)	206	0.705	.401			
MPhil/PhD	20(45.5)	44					
<b>Type of programme</b>							
Academic	61(41.8)	146	12.611	.002	1	0.72–2.82	.307
Professional	53(65.4)	81			1.43	0.46 – 3.20	.705
Both	14(60.9)	23			1.21		
<b>Faculty</b>							
Public health	85(63.9)	133	24.053	<.001	2.10	0.92–4.81	.079
Basic medical sciences	23(29.1)	79			0.58	0.23–1.43	.237
Clinical sciences and Dentistry	20(52.6)	38			1		



Table 6. Association between knowledge about research misconduct and variables

Variable	Knowledge of research misconduct				Multiple logistic regression		
	Good	Total	X <sup>2</sup>	P - value	Odds ratio (OR)	95% CI OR	P - value
<b>Age (years)</b>							
<=30	84(79.2)	106	0.059	.808	1		
>30	79(80.6)	98					
<b>Sex</b>							
Male	60(77.9)	77	0.302	.583	1		
Female	103(81.1)	127					
<b>Postgraduate programme</b>							
Masters	142(84.0)	169	10.421	.001	1.78	0.70–4.52	.225
MPhil/PhD	21(60.0)	35					
<b>Type of programme</b>							
Academic	75(72.1)	104	8.030	.018	1		
Professional	68(88.3)	77					
Both	20(87.0)	23					
<b>Faculty</b>							
Public health	108(87.8)	123	15.204	<.001	2.96	1.08–8.06	.034
Basic medical sciences	26(60.5)	43					
Clinical sciences and Dentistry	29(76.3)	38					

#### **4. DISCUSSION AND CONCLUSION**

This study showed that knowledge on research ethics was about average among the study participants, especially those belonging to the younger age group (< 30 years old), female gender, PhD degree programme and other faculties aside that of Public Health. These findings underscore the increasing importance of training in ethics of scientific research. It has been suggested that for all research to meet the highest ethical and scientific standards, persons who are involved in conducting research should be fully conversant with the relevant ethical principles of biomedical research and its requirements [8]. As observed by Mastroianni and Kahn [9], education in research ethics is an important tool required to equip student-researchers with requisite knowledge, skills and competence on responsible conduct of research. Therefore, it can be postulated that a well thought out Responsible Conduct of Research (RCR) training will assist researchers to effectively discharge their expected obligations – toward other researchers, toward oneself, and toward the public [10]. Likewise, those involved in animal research would be familiar with regulatory guidelines and procedures governing their work.

The awareness of the respondents on the three aspects of ethics of research explored in this study was high, but not all demonstrated good knowledge. Equally, the mean knowledge scores of research ethics issues were generally above average. Age was found to be a predictor of this knowledge, particularly research integrity. These findings seem to be supported by the observation that about half (53.2%) had not been exposed to research ethics training or instruction of any kind before registering for the current graduate programme. The findings are also suggestive of an on-going exposure to research ethics and responsible conduct of research education, but which might be either less effective or not totally inclusive for all participants involved in this study. Consequently, their adherence to ethical principles of biomedical research as beginning researchers could be considered as sub-optimal. Furthermore, their ability to discharge the three sets of obligations that motivate adherence to professional standards - i.e. an obligation to honour the trust that their colleagues place in them, an obligation to themselves and an obligation to act in ways that serve the public - is of great concern [10].

Male students generally recorded higher mean knowledge scores than their female counterparts on most of the areas of responsible conduct of research explored. Despite this finding, sex was not a predictor of knowledge in this study. Though this gender difference in knowledge could not be readily explained, studies have shown that females generally report decreased self-confidence, particularly over issues related to their competency compared to males [11,12]. Therefore, the finding is important as it may be found useful in designing female friendly training packages which would take into cognizance barriers such as timing, discrimination and stigmatization - all of which may prevent full participation of and effective learning by female students; furthermore, the issue of confidence might need to be addressed. Study participants who were undertaking a Master's degree programme also showed a higher mean knowledge of research ethics issues than Ph. D. students. This finding may be readily explained that majority of them were Master's students, who might have just been recently exposed to research ethics during their programme; this is in contrast to the Ph. D. students, whose exposure might not have been recent. This observation underscores the importance of periodic capacity building on research ethics for all graduate student researchers as long as their programmes last. This is not only desirable because it will help keep them on track as responsible researchers, but also appropriate as they were in their formative period.

It is noteworthy that researchers had previously suggested the need for periodic rather than one-time RCR training to counter the often conflicting views and practices young scientists experience in real-life research settings [13]. To this end, the National Code for Health Research Ethics (NCHRE) recommends that biomedical researchers undergo research ethics training at least once in two years [14]. Likewise, National Institutes of Health (NIH) new requirement stipulated that investigators trained with or receiving NIH support must receive formal instruction in the responsible conduct of research at least every four years [15]. From the foregoing, beginning researchers, like the participants in this study, would require a more frequent training contact than the intervals referenced above for two reasons. First, they need to be very conversant with skills required to uphold research integrity and resolve ethical dilemmas they will encounter in the conduct of their research. Second, researchers often are subject to great personal and professional pressures as they must make difficult decisions about how to design investigations, how to present their results, and how to interact with colleagues. Failure to make the right decisions can waste time and resources, slow the advancement of knowledge, and even undermine professional and personal trust [10].

In view of the above, an annual training at least in the first three years of beginning to conduct research is recommended for graduate students in the research setting; the frequency may then be reduced following a third time exposure. Frequent exposures would not only provide the student researchers the opportunity to be well grounded in research ethics as they pass through their formative years as researchers, but also prevent them from getting wrong ideas and experience about research which may hinder effective training at a later date as shown by Heitman et al [16] and Mc Gee et al [13].

This study found that the students of Public Health specialty generally demonstrated better and higher knowledge of research ethics issues than the students in the remaining three specialties. Furthermore, these students were about three times more likely than those from Basic Medical Sciences to have good knowledge of research misconduct. These findings were not surprising as 125 (61%) of 205 students, who responded 'yes' to having or receiving instruction or training on conduct of research and research ethics in their current graduate curriculum were located in the Faculty of Public Health. Previous similar studies conducted among research ethics trainees had reported same trends of improved awareness and knowledge [17,18]. On the contrary, students in the other specialties, especially Basic Medical Sciences and Dentistry, were disadvantaged as they were poorly exposed to research ethics issues; this explains why both their awareness and knowledge were significantly lower than their peers in the Public Health and Clinical Sciences specialties.

This observed differential in knowledge among the respondents has far reaching implications. First, a large group of students in the surveyed tertiary institution who are statutorily involved in research with human participants and laboratory animals had insufficient information on responsible conduct of research. Second, the integrity of human participants who had ever been and/or currently involved by these students in their research work seems at risk of being violated; likewise, laboratory animals commonly used for research by students in the Basic Medical Sciences specialty might have been and/or being subjected to poor research conditions, including animal cruelty. Third, as noted above, the culture of responsible conduct of research involving human participants and animals is expected to be a cornerstone of academic biomedical and behavioural research establishments such as the surveyed tertiary institution.

From the foregoing, the importance of integrating capacity building in research ethics as part of human resource development activities for all those involved in research enterprise, including graduate students, in an institution cannot be underscored. As a short-term measure, a quick intervention in addressing the above concern is to request graduate students in other specialties to register for and take the existing research ethics course of the Public Health specialty; though its scope might be expanded in order to address the immediate needs of the students. While this is on-going, it is suggested that audit of curricula of other graduate programmes should be undertaken to ascertain or otherwise the adequacy of exposure to research ethics education by other students in the institution. This effort would not only help or facilitate development of research ethics curricula for other graduate programmes, but will allow specific research concerns of students in different specialties to be addressed.

In order to vary teaching methods, these formal efforts should be complemented by other avenues of learning research ethics such as Collaborative Institutional Training Initiative (CITI) online course and organizing short RCR courses of one to two weeks' duration as suggested by over half of the study participants. Effectiveness of these complementary training approaches would be enhanced with the use of small group teachings and case methods [19], and if a certificate of completion obtained from the courses is made to count towards university's course grades; in addition, issuance of certificate would help students meet part of requirements for the approval of their research proposals. All these may help stimulate and sustain the interest and enthusiasm of the trainees.

Furthermore, the role of advising and mentoring, especially for beginning researchers, cannot be over-emphasized. Thus, it has been suggested that institutions must promote good advising and mentoring by rewarding individuals who exhibit these skills and by offering training in how to become a better adviser or mentor [10]. Furthermore, guidelines that spell out the expectations and responsibilities of advisers, mentors, advisees, and mentees should be readily available as this would help prevent or resolve conflicts [20,21].

Specific interventions are required to institutionalize the above suggested measures as a long-term strategy; institutionalization will not only ensure frequent trainings but also ensure that monitoring is adequately done. For example, tertiary institutions of learning might expand the operations of human resource unit beyond staff development to include students' hardship areas such as research ethics. To this end, the unit would need to utilize innovative approaches to identify and address special areas of need of students. Such approaches may require bridging gaps between all stakeholders such as students' groups, research management office, research integrity officer, institutional review board, postgraduate school board, bursary and external funders to identify needs and mobilize required resources.

Community engagement could be explored as part of corporate social responsibility of tertiary institutions in addressing the training needs of students in research ethics. Equipping human resource unit to publish and disseminate information and education on research ethics to students periodically in different forum is sine qua non to the success of this intervention. Thus, informational documents on research ethics could be produced in form of briefs and periodicals, and placed in strategic locations such as lecture rooms, halls of residence, porter's lodge, cafeteria, library, pay-less-shops, students' union offices, etc for ease of access to students. This innovative approach is expected to serve a wide population of students and has the potential of continuous sensitization of all students, including undergraduate and non-degree students all year round.

## **CONSENT**

Authors declare that written informed consent was obtained from all the participants for publication of this work.

## **ETHICAL APPROVAL**

Ethical approval was obtained from the University of Ibadan/University College Hospital (UI/UCH) Ethical Committee. Permission was granted by the respective departments of the students and verbal consent was obtained from each participant.

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## **COMPETING INTERESTS**

The authors hereby declare that there is no competing interest in relation to this work.

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