education sciences

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Evaluation of Pharmacy Students' Knowledge and Perception of Scientific Integrity

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Received: 15 January 2020; Accepted: 13 February 2020; Published: 15 February 2020

Abstract: Scientific integrity, proper research conduct and avoiding research misconduct including plagiarism, fabrication and falsification, are all essential to all disciplines. Since research experience is a recommended skill to gain during undergraduate education, undergraduate students need to be aware of research misconduct in order to avoid it. This study was carried out to determine the level of knowledge and awareness regarding research misconduct, and the independent factors that might contribute to attitudes towards research misconduct. In this cross-sectional study, a questionnaire was self-filled by pharmacy undergraduate students about their knowledge of practices in research misconduct. Among the respondents (n=800), 79.12% had poor knowledge, whereas 20.88% had good knowledge about research misconduct and research ethics. Furthermore, only 9% indicated having previous training in research conduct/misconduct, whereas 36.5% had previous training in research ethics. In conclusion, this study reflects insufficient knowledge and awareness about research misconduct concepts and their main terminologies among undergraduate pharmacy students, which emphasizes the importance of implanting proper training programs/courses on research ethics during students' academic years.

Keywords: students; knowledge; awareness; research misconduct; Jordan

1. Introduction

Research is associated with tremendous improvements in life, health and wellbeing. The accumulated knowledge worldwide led to the achievement of research integrity, which is based on the assumption that the knowledge presented is true, complete and unbiased [1]. Research integrity or scientific misconduct have received increasing attention in the literature in the last three decades [2]. The most common definition of scientific misconduct used by universities and publishers is: fabrication, falsification, and plagiarism in performing, reviewing research, proposing or reporting research results [3]. Academic misconduct, plagiarism, fabrication and falsification are all essential issues across all disciplines, including health care.

Fabrication and falsification of data are considered one of the most common unethical behaviors. Falsification of data includes: data creation, selective publication of results (e.g., to choose only those corresponding to the study goals), the omission of conflicting data, and the conscious exclusion or modification of data [4,5]. The Office of Research Integrity (ORI) defines plagiarism as "the theft or misappropriation of intellectual property", which includes the unauthorized use of ideas or methods obtained by a privileged communication, such as a manuscript review. Substantial unattributed textual copying of another's work means the unattributed imprecise, or nearly imprecise, copying of sentences or paragraphs, which greatly misleads the reader regarding the contributions of the author. Undergraduate students need to be aware and knowledgeable about research misconduct concepts

to help them in the research projects and research paper writing required for during their study. Inadequate training and experience about research ethics and misconduct was presented as a barrier to proper research conduct among undergraduate students [2]. This study was commenced to determine the level of knowledge and awareness regarding research misconduct among pharmacy students and factors that might contribute to this knowledge and awareness.

2. Methods

This was a cross-sectional study carried from 1st of July to 1st of October 2018 in the pharmacy faculties of major universities in Jordan (total number of students is about 4900). The convenient sampling method was used. The number of students approached was 952, and the final number of respondents was 800, with response rate of 84.0%. A pre-tested self-administered questionnaire was developed and used to obtain data on general information and the demographic characteristics of the participants, knowledge of research ethics concepts and terminologies, research integrity and research misconduct including fabrication, falsification and plagiarism, and previous research ethics training. Study participants were recruited at the end of academic forums including classes, seminars and meetings. Verbal informed consent was obtained before the questionnaire was administered from each participant. A detailed explanation of the study protocol was provided to each of the selected participants. Each participant was given a copy of the questionnaire to self-complete; a researcher was available all the time for clarifications and questions. The study was approved by Institutional Review Board (IRB) of Jordan University of Science and Technology (JUST).

A pilot testing of the questionnaire was done and feedback from pilot testing was considered in order to improve clarity and understanding of the questionnaire items in the final version. Data from the pilot sample were excluded from the final analysis. The final questionnaire is composed of three parts as follows: Part I was about demographics and general information, including gender, year of study, nationality, previous participation in clinical research, and if the participants had received ethics training previously. Part II was about the student's knowledge and awareness of terminologies of research misconduct, where the participants' awareness and knowledge of certain terminologies and definitions related to scientific research conduct/misconduct in clinical research were assessed [5,6]. Responses to knowledge questions were framed as a 3-point Scale (aware (I know), not aware (do not know), and not sure). Part III was about experience and knowledge of research misconduct. In this section, participant's knowledge and experiences of specific characteristics and descriptions of research misconduct, such as fabrication, plagiarism, and falsification, were assessed. Responses to these questions were framed as a 3-point Scale (correct, not correct, do not know). A Score of 7 was used to evaluate participants' knowledge, as a score of $6 \geq$ was considered good knowledge, while a score $<$ 6 was considered poor knowledge. The questionnaire was presented in English, which is the study language for university pharmacy students in Jordan.

3. Statistical Analysis

The characteristics of participants' variables were described using frequency distribution. Chi-square test was conducted to examine the distribution of participants' demographic characteristics according to their knowledge. A P-value of less than 0.05 was considered as the cut-off level for statistical significance.

4. Results

Table 1 demonstrates the demographic characteristics of the participants. In general, most of the respondents were females (81.63%), and the majority were in their 3rd year of study or more (66.63%). More than half of the respondents (68.11%) did not have any previous undergraduate research experience. When the respondents were asked about previous participation in research misconduct training, only 9% indicated they had had such participation, whereas 36.5% had previously participated in research ethics training courses.

Table 1. Demographic characteristics of study participants (n= 800).

Variable	n (%)
Gender	
Male	147 (18.37)
Female	653 (81.63)
Year of study	
1st year	145 (18.12)
2nd year	122 (15.25)
3rd year	160 (20.00)
4th year	193 (24.13)
5th year	180 (22.50)
Nationality	
Jordanian	751 (93.9)
Non-Jordanian	49 (6.1)
Undergraduate research experience	
Yes	255 (31.89)
No	545 (68.11)
Previous research ethics training	
Yes	292 (36.5)
No	508 (63.5)
Previous research misconduct training	
Yes	72 (9)
No	608 (76)
Not sure	120 (15)

Table 2 reveals the responses about the terminologies of research misconduct. More than half of the responders were aware of the terminology of ethics committee's (63.60%). Almost half of the students were aware of responsible conduct research terminology (55%). Around 44.81% knew about informed consent. However, only 16% knew about the Declaration of Helsinki. Regarding their knowledge about plagiarism, fabrication, and falsification, less than half were aware of such terms (47.98%, 43.54%, and 43.18%, respectively).

Table 2. Students' knowledge and awareness of research misconduct terminologies.

	n (%)		
Terminology	**Aware (I Know)**	**Not Aware (Do not Know)**	**Not Sure**
Responsible conduct of research	440 (55)	224 (28)	136 (17)
Informed consent	358 (44.81)	319 (39.92)	122 (15.27)
Declaration of Helsinki	128 (16)	533 (66.63)	139 (17.37)
Institutional Review Board (IRB)	242 (30.48)	423 (53.28)	129 (16.24)
Ethics committees	505 (63.60)	186 (23.43)	103 (12.97)
Disclosure of conflict of interest	254 (32.19)	398 (50.44)	137 (17.37)
Plagiarism	381 (47.98)	309 (38.92)	104 (13.10)
Fabrication	347 (43.54)	339 (42.54)	111 (13.92)
Falsification	327 (41.29)	342 (43.18)	123 (15.53)

N*: number of responses.

Table 3 reveals the responders answers regarding their knowledge and awareness of research misconduct, where 56.48% knew the main consequences of research misconduct, and 52.13% could determine that paraphrasing is a kind of plagiarism. Besides that, 43% of responders could correctly answer that plagiarized publications do not add to the scientific value of the material published.

Moreover, only 40.23% and 40.15% of respondents could distinguish the correct descriptions of falsification and fabrication, respectively. Other respondents' answers to statements regarding research misconduct knowledge are shown in Table 3.

Table 3. Pharmacy students' knowledge and awareness regarding research misconduct.

	n %		
Item	**Correct**	**Incorrect**	**Do not Know**
Publication ethics in research is an essential element of paper writing.	480 (60.45)	212 (26.70)	102 (12.85)
The main consequences of research misconduct are, losing public trust, placing research subjects at risk and wasting resources.	449 (56.48)	236 (29.69)	110 (13.83)
Plagiarism involves the use of writings belonging to others or copying part of own previous published work, without appropriate citation.	395 (49.81)	285 (35.94)	113 (14.25)
Plagiarized publications do not add to scientific value of the material published. They increase the amount of published papers without justification and gain undeserved benefit to authors.	342 (43.02)	299 (37.61)	154 (19.37)
Paraphrasing means to express someone else's ideas in your own language and to summarize means to write down the essence of someone else's work.	416 (52.13)	257 (32.21)	125 (15.66)
Falsification in research is defined as omitting data such that the research is not accurately represented, manipulating research materials, and changing data or results.	321 (40.23)	313 (39.22)	164 (20.55)
Fabrication in research can be described as to pay someone to write a paper for you, or provide two or more references for contradictory statement, or cite a source that has not actually been read or consulted.	320 (40.15)	308 (38.65)	169 (21.20)

When comparing the distribution of knowledge about research ethics among students according to their demographics, both gender and years of study showed significant association with knowledge (Table 4), where females had a higher percentage of good knowledge compared to males (22.97%, 14.96%, p <0.05). The percentage of students in the good knowledge group was higher among students with more years of study. For example, only 11.03% of students in the first year achieved good knowledge, while 22.79% and 30.55% of students in the 4th year and 5th year and above, respectively, had good knowledge of research misconduct. Overall knowledge score of research misconduct was poor for 633 students (79.12%) with knowledge score <6, while 167 students (20.88%) had a good knowledge score (≥ 6). Regarding participation in research ethics and research misconduct training, they were both associated with good knowledge Table 4.

Table 4. Distribution of Knowledge of Research Ethics among students according to Demographics.

Variable	**Research Misconduct Knowledge Score**		
	Good n (%)	**Poor n (%)**	***p*-value**
Gender			
Male	22 (14.96)	125 (85.03)	X^2 (2, N = 800) = 4.56, p = 0.0320
Female	150 (22.97)	503 (77.03)	
Year of study			
1st year	16 (11.03)	129 (88.96)	X^2 (5, N = 800) = 21.44, p = 0.0003
2nd year	22 (18.03)	100 (81.96)	
3rd year	29 (18.12)	131 (81.87)	
4th year	44 (22.79)	149 (77.21)	
5th year	55 (30.55)	124 (68.88)	
Undergraduate research experience			
Yes	60 (23.52)	195 (76.47)	X^2 (2, N = 800) = 1.60, p = 0.2064
No	107 (19.63)	438 (69.19)	
Previous research ethics training			
Yes	81 (27.74)	211 (72.26)	X^2 (2, N = 800) = 14.2, p = 0.0002
No	84 (16.54)	424 (83.46)	
Previous research misconduct training			
Yes	25 (34.72%)	47 (65.27%)	X^2 (2, N = 800) = 9.19, p = 0.0024
No	142 (19.50%)	586 (81.00%)	

5. Discussion

The current study was conducted to assess pharmacy students' knowledge and awareness of research integrity, and misconduct in Jordan. Insufficient knowledge was most noticed un the 1st, 2nd, and 3rd years, but good knowledge was noted in the 4th, 5th, and 6th years. This was comparable to a study by Mubeen et al. in four medical colleges of Karachi. In that study, deficiencies in knowledge regarding several aspects of publication ethics were shown among medical students of both public and private medical colleges where poor knowledge about fabrication of data and scientific misconduct in publications was reported [6]. These findings emphasize the increasing importance of raising awareness and the training of research and publication ethics among undergraduate students during their academic years.

The knowledge of pharmacy students about specific research misconduct terminologies was found to be comparable with a previous investigation of pharmacy students in a Japanese University Hospital [7]. Current and previous results indicate that scientific misconduct represents a significant issue that needs to be addressed [7]. In the current study, almost less than half of responders were aware of research misconduct terminologies such as plagiarism, fabrication, and falsification. Moreover, less than half could recognize the correct descriptions of plagiarism, fabrication and falsification. This was comparable to a study done in PharmD students of the United States to test their ability to identify plagiarism before and after introducing an educational intervention about plagiarism. Notably, the intervention resulted in a significant improvement in students' attitudes towards plagiarism [8].

Notably, only half of the respondents could differentiate what the consequences of research misconduct are, which may be related to insufficient and planned lectures for ethics training during academic years. These findings were close to a study done at American University in Cairo, which included undergraduates, post-graduates and faculty members, to evaluate attitudes toward research misconduct, where there was a lack of understanding and awareness of the unethical nature of research misconducts related to level of education and work environment in addition to the possible ineffectiveness of training [9].

This study has some limitations, including the use of convenient sampling and a survey tool that tested for only the basic terminologies and concepts related to research integrity and research misconduct. A comprehensive future study is recommended, utilizing random sampling and a detailed assessment of concepts related to the responsible conduct of research, including research integrity and research misconduct.

In conclusion, results of the current study revealed insufficient knowledge and awareness of research misconduct among pharmacy students in Jordan. The majority of responders were not aware of the main ethical aspects of research misconduct, including plagiarism, fabrication, and falsification. The results of this study emphasize the importance of proper and planned ethics in research and research misconduct training during the students' academic years. Such training is recommended as it will improve students' abilities to identify as well as understand the importance of ethical aspects in research, and be aware of the different types of research misconduct.

Author Contributions: R.A.A. designed and prepared the study questionnaire, collected data and helped in analyzing and interpreting the data. K.H.A. participated in study design, preparing the study questionnaire, data analysis and was a major contributor in writing the manuscript. M.A.A. helped in study design, data interpretation and manuscript writing. All authors read and approved the final manuscript.

Funding: This research was funded by grant # 5R25TW010026-02 from the Fogarty International Center of the U.S. National Institutes of Health.

Conflicts of Interest: The authors declare no conflicts of interest.

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