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Original Article

Association of academic education and practical capabilities of radiology technologists

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Abstract
Introduction: Radiology is a complex health science and profession, requiring experienced use of academic technology, beside the ability of thinking critically, independent judgment, solving problems creatively and communicating effectively to make the best clinical performance. The present study was designed to evaluate the practical capability of radiology technologists working in radiology wards, for determining the level of association between capability and academic education.
Methods: In a cross-sectional analytical study carried out at Tabriz University of Medical Sciences, Iran, in 2010-2012, the radiology technologists were asked to fill the previously-designed questionnaires which was included a checklist related to the participants' social and demographic characteristics, and a questionnaire on the radiology technologists' performance regarding the medical applications of X-ray.
Results: The mean age was 35.03 ± 8.01 year, and 64 (53.3%) were male. The technologists' capability had a significant relation with their educational degree, and the capability of staff with BS was more than those with an associate degree ($P < 0.001$). The technologists' capability was directly related to their grade point average (GPAs) within "associate degree" group ($P < 0.001$), but no such correlation was found among "BSc" group. In total, there was a direct relation between the academic training and practical capability ($P = 0.040$).
Conclusion: A great majority of the technologists do not seem to base their capability on the recognized scientific sources. Teaching or familiarizing the students with the true concept of performing on the basis of the prior training, and the significance of implementing such training in professional activities is one of the approaches, which could lead the technologists to appreciate the relationship between classical training and their providing quality services.

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Introduction

Radiology is a complex health science and profession, requiring experienced use of academic technology, beside the ability of thinking critically, independent judgment, solving problems creatively and communicating effectively to make the best clinical performance.[1]

Contemporary medicine relies heavily on radiological investigations and procedures. The use of procedures with a high load of radiation continues to grow steadily.[2] The medical sources of radiation in industrialized countries may therefore soon be greater than natural sources.[3] High doses of ionizing radiation clearly produce deleterious consequences in humans.[4,5] Given that it is supported by experimentally grounded, quantifiable,

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biophysical arguments, a linear extrapolation of cancer risks from intermediate to very low doses currently appears to be the most appropriate methodology.[5]

In some hospitals, patients are now more likely to get a total body scan than a thorough history and careful physical examination. Modern physicians are good at talking with complicated machines but not always as good at listening to patients. In their turn, patients often demand more examinations and feel reassured by high tech ones. The economic drive of expensive testing and doctors' legitimate concerns about medicolegal action if they don't use the latest investigations have done the rest.[2]

The Euratom law establishes that the need for an examination should be justified before a patient is referred to a radiologist or nuclear medicine physician and that a non-ionizing technique must be used whenever it will give grossly comparable information to an ionizing investigation.[3,6]

Lack of accordance between academic education and its application in the profession, practice-theory gap, is a main concern in medical education. Human resources constitute the cornerstone of health systems and if their educational programs are not based on the health and social status of countries, it cannot improve their health to the level that enable the people to have socially and economically productive life. Also, insufficient education of health care providers can threat the people as the main possession of every society.[7]

Medical radiation accounts for the most important human-made radiation that aimed at access to the best images with the minimum radiation to the patient. Obviously, the dose absorbed by patient can be limited and lowered using the protection instructions. Images with low quality requiring repeated imaging increase the patients' exposure to the radiation.[5] Regarding the fact that the unfavorable effects of radiation on life have been confirmed and X and gamma rays have been known carcinogen by International Agency for Research on Cancer,[3] one can minimize radiation side effects by lowering unnecessary applications and optimization of studies to providing high-quality radiographies with minimum exposure.[4] So, the technologists must be trained to learn the appropriate application of radiology during academic education in order to use them in clinical practice and improve their active role in their routine function to lower unnecessary radiation for patients and personnel.

In our experiences, what occurs in practice may suggest the absence of accordance between academic theory educations and professional capability of radiology technologists. Review of literatures showed that in spite of the need for conclusive research, there is not any published study in this regard in our or even another countries.

The present study was designed to evaluate the practical capability of radiology technologists working in radiology wards, for determining the level of association between capability and academic education.

Methods

During present cross-sectional analytical study, 120 radiology technologists in Tabriz University of Medical Sciences, Iran, since June 2010 till June 2012 were entered into the study. The studied cases were selected randomly using the RandList 1.2 software. So, according the randomly selected numbers, a technologist belonging to each number was enrolled.

The data collection tool included a checklist related to the participants' social and demographic characteristics (age, sex, marriage status, history of employment, duration and location of occupation, and academic achievement) and a questionnaire evaluating the capability of radiology technologists regarding the medical applications of X-ray. The questionnaire included 17 questions regarding their practical capability, which had content validity, and its reliability had been obtained through calculation of Cronbach's alpha coefficient. This coefficient was calculated as 0.76 in this study, suggesting an excellent reliability.

The previously-designed questionnaires were provided to radiology technologists in their workplace at radiology ward, and they

asked to fill them in the presence of the provider. All studied cases had personal satisfaction for participation in the study. Any of them had the choice of leaving the research without any interpellation.

Descriptive statistical methods, chi-square test, independent samples t-test, and Spearman's correlation coefficient were applied for data analysis using SPSS software (version 15, SPSS Inc., Chicago, IL, USA). The $P < 0.050$ was considered to be statistically significant.

Results

A total of 120 radiology technologists filled the questionnaires. The mean age of the participants in the study was 35.03 ± 8.01 years (range, 23-50 year) and 50.0% had the age less than 33 years. 64 (53.3%) were male, and 56 (46.7%) were female. The mean age of males were 38.92 ± 8.59 years, and for females were 31.77 ± 7.21 years ($P < 0.050$).

The educational degree was an associate degree in 46 (38.3%) and BS or MS in 74 (61.7%). 40 (36.0%) were graduated from Tabriz University of Medical Sciences and 46 (41.4%) from Tehran Universities, Iran. The mean age of Associate Degree group and BS group was 35.72 ± 9.66 and 35.40 ± 8.10 years respectively ($P = 0.840$). The sex distribution was not statistically significant between the two groups ($P = 0.420$).

Most of the participants with Associate degree have been graduated in 2003, and most of cases with BS degree have been graduated in 2001. 50 cases (47.1%) were employee of teaching hospitals of Tabriz University of Medical Sciences. In average, the history of working in radiology wards was 10.49 ± 8.04 years. The grade point average (GPAs) was 15.71 ± 1.50 point among the participants with associate degree and 16.24 ± 1.23 point within those with BS degree ($r_s = 0.42$, $n = 120$, $P = 0.030$).

53 cases (46.1%) have participated in specialized educational courses during the employment or have conducted educational courses or workshops in academic centers. Table 1 shows some of questions and responses about educational courses during the employment.

To the question that "if the academic education of radiology is necessary for different stages?" 53 cases (46.1%) replied "yes". Regarding the suitable course for training the radiology technologists, 5 participants (4.2%) suggested 6 months course, 17 cases (14.3%) suggested associate degree course, 55 participants (46.2%) suggested BS course, and 42 cases (35.3%) suggested MSc course.

The most important references used for learning radiology techniques during the academic courses were Meryl and Clarke textbooks in 53 participants (31.6%), and lectures and courses presented by BSs students and educational staff in radiology wards in 37 participants (31.6%), by academic members in 19 participants (16.2%), and by radiologists in 8 participants (6.8%).

The response to the question that "the radiology techniques performed on patients are based on which of scientific references?" the responses were as following: the routine program among technologists in the ward (n = 36; 30.3%), opinion of radiologist in radiology ward (n = 31; 26.1%), educations provided by academic members (n = 27;

Table 1. Some questions about educational courses or workshops during the employment

Questions	*Response				
	Very low	Low	Some	High	Very high
If the participation in these courses have been effective in the quality of your work?	4 (6.0)	5 (7.5)	25 (37.3)	22 (32.8)	11 (16.4)
If the participation in these courses have been effective in increasing your knowledge?	2 (3.0)	5 (7.6)	24 (36.4)	24 (36.4)	11 (16.7)
How much of the theory and academic educations are used in professional practice?	1 (0.8)	8 (6.7)	46 (38.7)	51 (49.9)	13 (10.9)

*Data were showed as n (%)

22.7%), and educations provided by staff in hospitals during (n = 25; 21%).

The average score that were given for participants' capability was 8.85 ± 2.69 point (range: 1-14 point). The capability of technologists was evaluated using the normal curve that showed a moderate capability, so that they achieved the score 8-12 point (range: 1-14 point).

The spearman's correlation coefficient showed the absence of relation to the age and capability of technologists. The independent samples t-test showed that the average score of capability was significantly more in men than women (P = 0.040). Also, the capability was related significantly with the academic degree, and the capability of staff with BS was more than those with an associate degree (P < 0.001).

The capability was correlation significantly with the GPAs in associate degree course (r_s = 0.70, n = 120, P < 0.001) so that the capability was more in those with higher GPAs; however, the capability was not related significantly with the GPAs in BS course (P > 0.050). The spearman's correlation coefficient showed the weak but significant correlation between academic educations and capability of radiology technologists (r_s = 0.24, n = 120, P = 0.040).

Discussion

We evaluated the professional capability of radiology technologists working in radiology wards, for determining the level of accordance between capability and classic academic education. The results of this study showed that the extent of using classic educations in professional capability of radiology technologists was low, so that to the question "the radiology technics performed on patients are based on what scientific references?" 30.3% of participants replied that they followed the routine program of technologists working in that ward and only 22.7% were believed that obey the educations learned from academic members during the academic course.

Beside the need for updating educational materials,[8] there is increasing importance on actual educational accreditation of graduate's ability with the aim of assessment of the graduate's ability to meet the demands of new practice environment.[9] Ryding and Murphy suggested that graduates of the newer and revised curriculum had a higher level of performance.[10] Delaram suggested that revised educational curriculum and assessment processes, and improved educational performance of instructors are important factors effecting on graduates' professional function.[11] Also, it must be mentioned that insufficient education and learning among clinicians can threat the humans' health.[12]

Although there is not conclusive study about the professional capability of radiology technologists, some related studies show that the high percentage of technologists does not use (or use seldom) from classic academic education.[5]

The extent of use of classic educations in this study was evaluated by indices including technologists' capability in special cases, the knowledge used by technologists, and the skill and clinical capability of technologists. The majority of technologists believed that the academic radiology education in any grade is necessary and participation in educational courses improve the quality of their practice and had positive attitude to classic education and the application of it in professional practice; however, most of them (53.9%) have not participated in any educational course.

The results showed that in spite of positive attitude in technologists, there are obstacles for the application of classic educations that must be resolved. So, the good attitude is necessary for the application of classic education in routine practices of radiology technologists but it is not sufficient.

It seems that a reason for not application of classic educations in professional practices by radiology technologists is lack of continuous education programs and lack of motive required for improvement of information and knowledge in technologists,

so that most of the participants (36.4%) believed that participation in continuous education programs is efficient in improvement of their skills.

The correlation between professional capability of radiology technologists and academic education were not affected significantly by age, but were affected by academic degree, average grade point of associated degree, and participation in short-term educational courses. Also, the professional capability was better in men than women, indicating the effect of gender in the professional skill.

The connection between the benefits of academic learning and necessary workplace skills, particularly in the areas of critical thinking, creative problem solving and communication skills, suggests that learning techniques may be particularly useful in the education of future radiologic technologists.[1]

Yoho et al. evaluated the relationship between academic medical education in the first 2 years and clinical performance in year 3, and found significant correlations. These results help define the relationship between student academic and clinical performance and suggest that nonacademic characteristics may play a pivotal role in clinical abilities. These characteristics need to be further identified and developed in the academic curriculum. There may be attributes identified that also benefit the admissions process.[13]

One study on clinical education in Amsterdam showed that there is a need for adequate supervision, exposure, competency assessment and additional practical education to optimize training course and ensure good performance. They suggested that faculties are the main responsible for learning during training course and their support, and balanced investment in teaching (time and money) is essential.[14]

Although exploring differences between teaching and non-teaching centers was not the focus of this survey, the number of participants in both centers was not statistically different. However, the teaching hospitals in previous studies appeared to show better capability compared with non-teaching hospitals.[15-20] The perceived need for training of a personnel of academically oriented diagnostic radiology has been well documented,[21,22] and the American Board of Radiology responded to that need by training programs.[23]

In one study in Newcastle, Australia on nursing students, the four categories that potentially impact on nursing students' academic and clinical performance were: demographic, academic, cognitive and personality/behavioral factors, and the authors recommended to the universities to develop strategies aimed at addressing this factors.[24]

Previous studies found that older students' had better academic performance than younger students.[24-28] However, our results showed the absence of relation to the age and capability of technologists. Some studies found no correlation between gender and academic performance.[29,30] However, nurses in Pakistan performed significantly better.[31] Gender was identified as a strong predictor of attrition in three UK studies. The males were less likely than females to remain in a nursing program.[32,33] Our results showed that the performance was significantly more in men than women.

In view of demands for high-quality care, many health care systems aim to assess clinicians' professional performance.[34-38] The purpose is to give feedback to clinicians so that they can steer their professional development plans toward achieving performance excellence.[35]

The study has some limitations. We used only the technologists working in a one region, so, a more conclusive and multifocal study on technologists graduated from different universities and working in various centers is suggested.

Conclusion

In conclusion, most of technologists do not make their professional function in basis of updated and scientific references, while we live in a world with rapid scientific production and improvement, and one must use the newest and the most efficient methods in the professional practice.

Education and training of the technologists about the concept of education based practice and the value of its application in professional practice is a way to improve the quality of services provided by technologists.

Conflict of Interests

Authors have no conflict of interest.

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